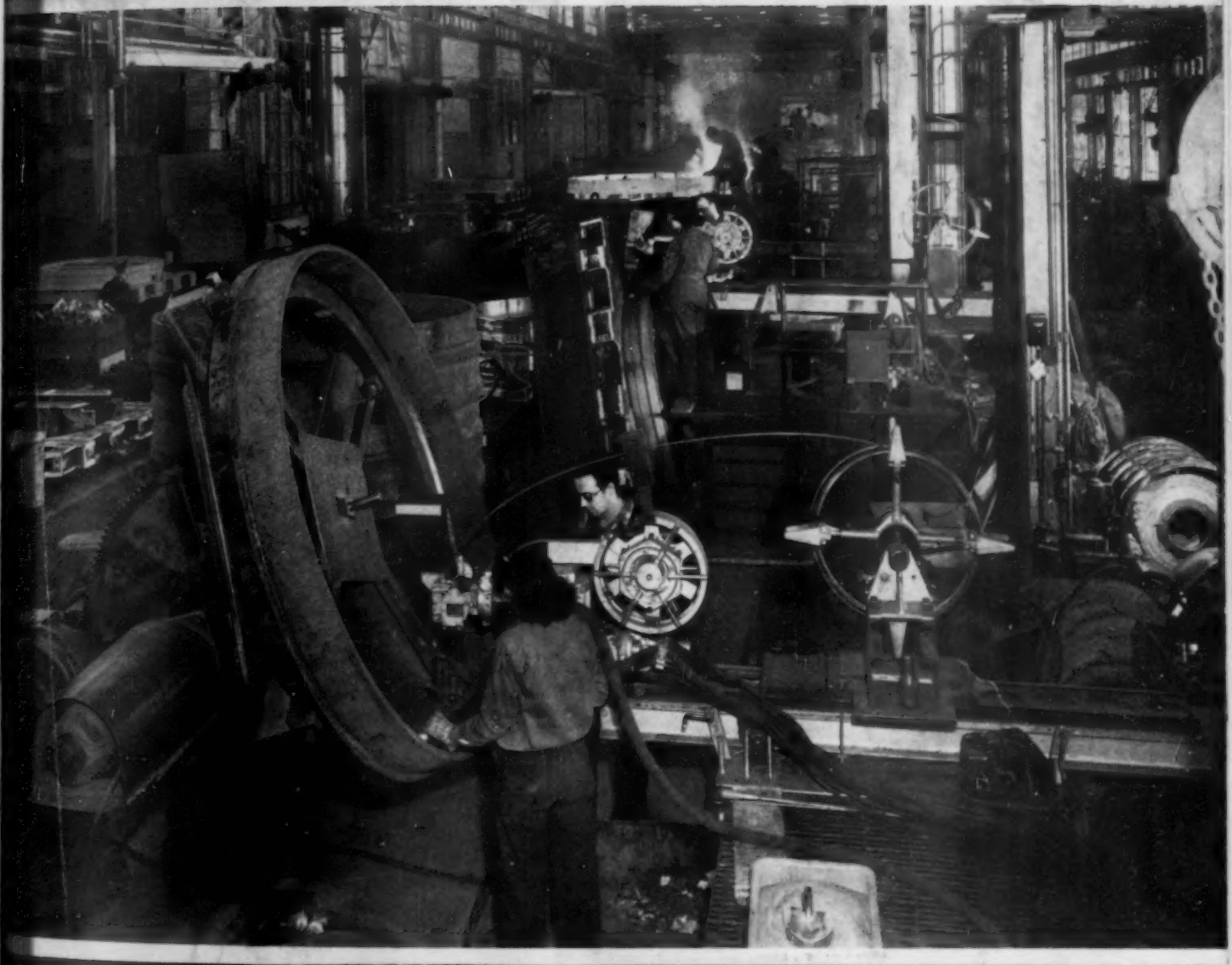
AUGUST 1943

WELDING

Journal



The Journal of the American Welding Society

ARCOS ELECTRODE
STUB END IDENTIFICATION
COLOR CHART

For Arcos Electrodes manufactured after May 1, 1942

GRADE	TYPE No. (See Note)	END COLOR (Primary)	SIDE COLOR (Secondary)
Chromend 16/7	301X	Yellow	Black
Chromend K	308	Yellow	.....
Chromang	307	Black	.....
Chromend 19/9 Cb	347	Yellow	Blue
Chromend K-Mo	316	Yellow	White
Chromend K-Mo-Cb	316 + Cb	Yellow	Green
Chromend 18/8 Mo	317	Yellow	Brown
Chromend KS	302 + B	Yellow	Red
Stainlend K	308	Black	.....
Chromend HC	309	Black	White
Chromend 25/12 Cb	309 + Cb	Black	Blue
Stainlend HC	309	Red	White
Chromend HCN	310	Red	.....
Chromend 25/20 Cb	310 + Cb	Red	Blue
Chromend 25/20 Mo	310 + Mo	Green	White
Chromend HN	311	Green	Light Green
Chromend 8/18	325	Green	Brown
Chromend 25/3 Mo	329	Green	Yellow
Chromend 29/9	312	Green	Red
Chromend 15/35	330	Green	.....
Chromend 13/60	.....	Green	Blue
Chromend 13/75	Inconel	Green	Orange
Chromend 15/85	.....	Light Green	White
Chromend 20/80	.....	Black	White
Nickelend	Nickel	Grey	Orange
Chromend 2M	2% Cr.—Mo.	.....	.....
Manganend 2M(S)	Special	Grey	.....
Chromend 5M	502	Grey	Blue
Chromend 12	410	Grey	Brown
Chromend 16	430	Grey	Green
Chromend 18	442	Grey	Red
Chromend 28	446	Orange	Yellow
Mixend	Monel	Orange	Blue
Reformend	M. S. for C. I.	Orange	.....
Manganend 13	13% Mn. Steel	.....	Red
Bronzend E	Everdur	.....	.....
Bronzend P	Phos. Bronze	.....	.....
Carend	Mild Steel	.....	.....

Note:—Type numbers are those of the American Iron and Steel Institute. The weld metal analysis nearest to that specified by A.I.S.T. is the one here used for reference.

NOTE: Where the grade name indicates analysis, the first figure is the % Chromium and the second figure is the % Nickel. (For instance, Chromend 20/80 is 20% Cr. and 80% Ni.)

A copy of this chart may be obtained from Arcos Corporation or any of their distributors listed below.

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Kingsport, Tenn.....Slip-Not Belting Corp.
Los Angeles, Calif.....Victor Equipment Co.
Milwaukee, Wis....Machinery & Welder Corp.
Moline, Ill.....Machinery & Welder Corp.
New Orleans, La.....Wm. D. Seymour Co.
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Oklahoma City, Okla..Hart Industrial Supply Co.
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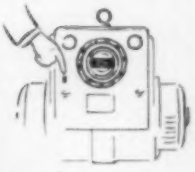

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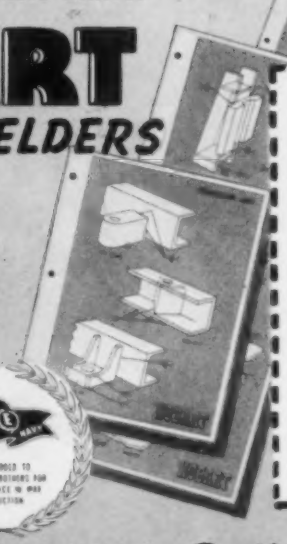

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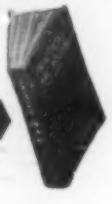

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The Journal of the American Welding Society

Published for the Advancement of the Science and Art of Welding

W. SPRARAGEN, Editor

August 1943

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COVER

Automatic Welding of Navy 5" Gun Mount Base Ring. *Courtesy Northern Pump Company.*

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An Outdoor Substation Structure Designed for Welding*

By R. W. DeVore†

Introduction

THE application of arc welding to the design of an outdoor substation structure is the subject of this paper. Consideration is given to a general description of an outdoor substation, its functions and certain of the limitations involved in its design. The particular type of structure chosen for this report is described in some detail and comparisons are made as to weight and cost between the included design finally adopted and an alternate design based on standard practice.

Description and Function of a Substation Structure

First it might be well to describe briefly the functions of an outdoor substation and to mention some of its characteristics. It involves a skeleton structure which supports the various switches, breakers, lightning arresters, conduit and insulators and other electrical equipment necessary for high-voltage electrical power distribution. In one respect, it is a steel foundation or base for the electrical apparatus. As such it must be accurately fabricated with small tolerances.

Electric conduits and cables through the structure require certain ground clearances and usually a minimum of diagonal bracing is used. Often the structures are of rigid frame construction with no bracing other than that in trusses and columns and their intersections. Such structures must have considerable inherent rigidity.

Magnitude of Loadings

Equipment loadings are often of a type that tends to rack or twist the members of the structure. At times the various switches and insulators are connected by stiff conduit and any tendency of the supporting members to twist or have excessive deflection may break an insulator or otherwise cause trouble. Rather severe torsional strains are induced by the weight of bus bars when they are held by horizontal insulators projecting out 3 or 4 ft. from the side of a beam.

Sometimes the equipment loadings are of minor importance and the principal loads to be carried by the structure will be external line pulls or wind loads and the weight of the structure itself. Such a structure is that illustrated in Fig. 1. Line pulls vary, depending upon the electrical layout, from 500 lb. up to one-half the breaking strength of the lines which may be as much as 8000 lb. Usually they are limited by spring tension devices to around 2000 lb.

Wind loads, depending upon the type of structure, are usually between 20 and 30 lb. per square foot of projected area of the structural members.

Size of Outdoor Substation Structures

Outdoor substations vary in size from small 11-kva. stations which may be 18 or 20 ft. high and weigh a ton or less to high-voltage structures over 100 ft. high and many hundreds of feet long and wide involving several hundred tons of steel. The 140-kva. transformer struc-

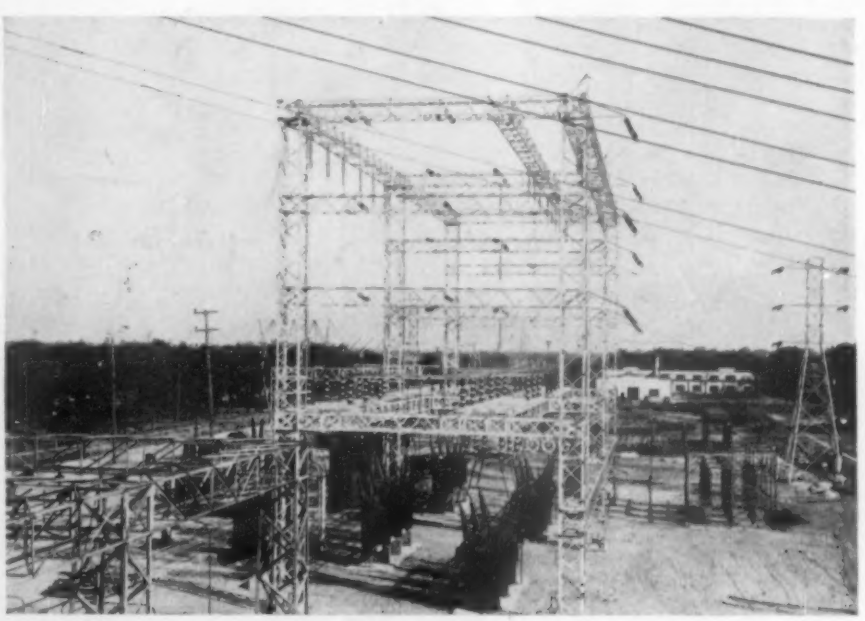


Fig. 1

* Third Prize Award paper in Class E-4, Structural, Miscellaneous Division of the 1940–42 Industrial Progress Award Program sponsored by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

† Structural Engineer, General Engineering Dept., The Commonwealth & Southern Corp., Jackson, Mich.

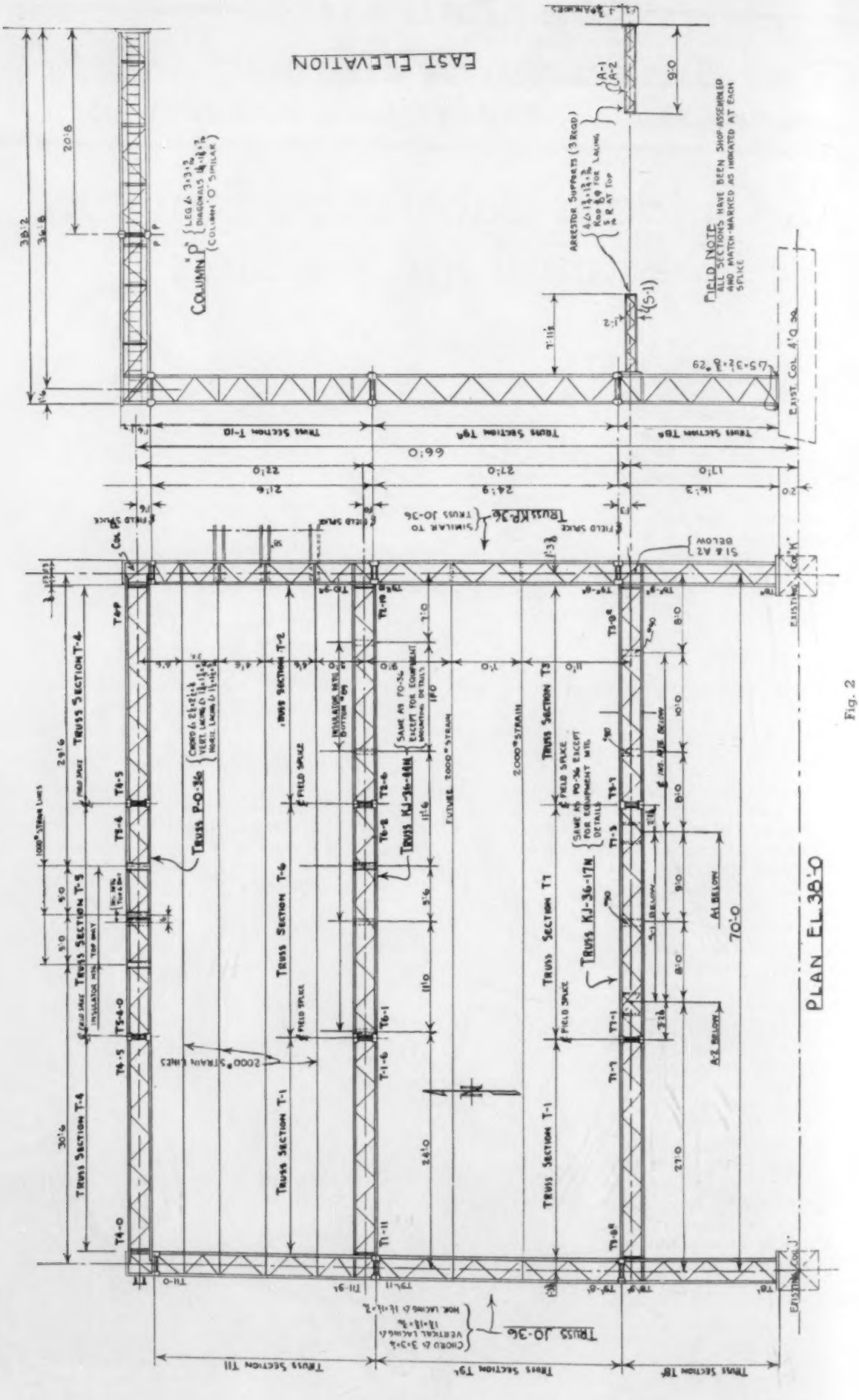

EAST ELEVATION
PLAN EL. 38'-0
COLUMN "P"
FIELD NOTE
ALL SECTIONS HAVE BEEN SHOP ASSEMBLED AND MATCH MARKED AS INDICATED AT EACH SPLICE
TRUSS P-0-36
TRUSS KJ-36-17N
TRUSS KJ-36-14N
TRUSS J0-36
TRUSS SECTION T-1
TRUSS SECTION T-2
TRUSS SECTION T-3
TRUSS SECTION T-4
TRUSS SECTION T-5
TRUSS SECTION T-6
TRUSS SECTION T7
TRUSS SECTION T8
TRUSS SECTION T9
TRUSS SECTION T10
TRUSS SECTION T11
FIELD SPLICE
2000* STRAIN LINES
EXIST. COL. 4'0 SQ.
70'-0

Fig. 2

ture illustrated in Fig. 1 has two 47-ft. 0-in. x 70-ft. 0-in. bays cc of columns, is 85 ft. 0 in. high and contains approximately 90 tons of steel.

The smaller structures are usually made up of angles or the light-weight beams and stanchions, while structures such as that illustrated are made up of box trusses and box columns.

Limitations in Design

The structure must be of a type of construction that will insure a minimum of maintenance expense as any repairs would require taking part, or all of the station out of service, thus resulting in lack of power to the consumer or expensive temporary change-overs must be made. At present, the ideal answer to this requirement seems to be a galvanized steel structure.

Galvanizing in turn limits the over-all size of members that can be shop assembled and shop riveted or welded. It also limits the field connecting to the use of bolts as riveting or field welding will destroy the galvanizing over a certain area around the rivet or weld. In the past shop rivets were sometimes used but it was found that galvanizing over the shop riveting was unsatisfactory so that up to the present time all shop and field connections have been made with galvanized bolts.

Another factor in favor of bolted structures has been the ease with which changes and additions could be made.

To economically satisfy the aforementioned loadings, substation structures must be light in weight, yet have ample rigidity. The columns and beams must have long spans with minimum deflections. They must be made up of galvanized members and the field connections must be bolted. With such limitations, it was decided to design a structure for welding and compare it with a standard design.

Design of the Welded Structure

One of the more common types of structures for outdoor substations is the high-voltage transformer structure illustrated in Fig. 1. An addition to a structure of this type is the subject of this paper.

One of the first things that was done was to set up the basic features of the design as listed:

1. Trusses and columns would be shop fabricated in the largest possible sections to insure a minimum of field connections.
2. All field-bolted joints would be designed to fully develop the various truss and column sections.
3. The structure would be considered as a continuous rigid frame in the stress analysis.
4. All fabricated sections would be shop assembled before galvanizing to insure proper alignment, dimensions and joint fit.
5. All holes for field connections would be subpunched $^{9}/_{16}$ in. diameter and, after shop assembling, reamed to $^{25}/_{32}$ in. diameter for $^{3}/_{4}$-in. bolts.
6. Future additions or revisions would be made using clamped-on details so that there need be no reduction in the area of the chord members for holes.

After investigating the capacity of the various steel fabricators' galvanizing tanks, it was decided to limit the size of fabricated sections to 2 ft. 6 in. wide x 3 ft. 6 in. deep by 28 ft. long. This was the largest size that could be galvanized in one or two dips by all the fabricators who were expected to bid on the structure. As shown in Fig. 2, these sizes worked out well for the various trusses and columns of the new structure, although the existing station to which it was being attached had

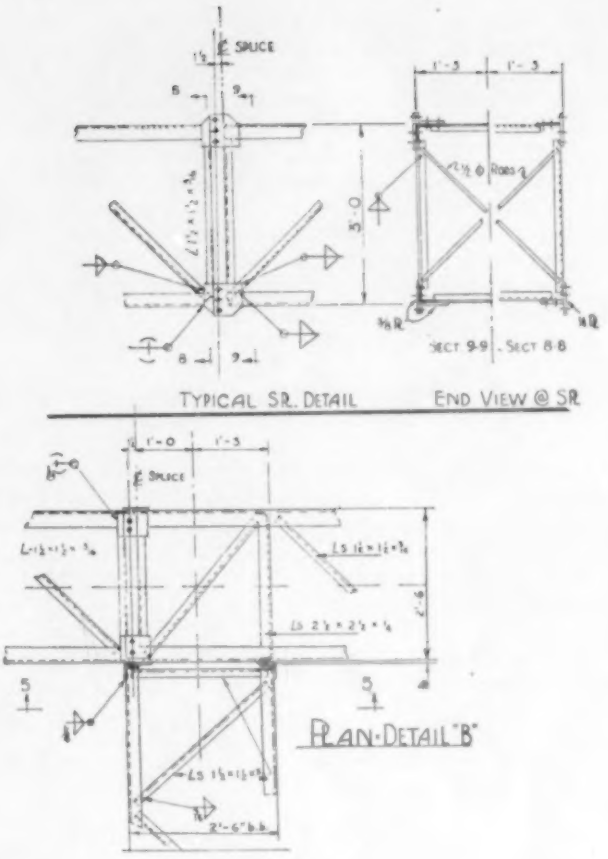


Fig. 3

3 ft. 0 in. square trusses and 4 ft. 0 in. square columns.

A typical splice for the box section was designed which utilized five $^{3}/_{4}$-in. bolts in single shear. Specifications allowed 6000 lb. per bolt in shear and bearing requirements were met with a $^{5}/_{16}$-in. plate. The design is shown in Fig. 3. Bolts were balanced in so far as possible about the neutral axis of the angle. Standard bolted angle splices involving a splice angle and splice bars cannot develop more than 60 to 70% of the chord angle due to necessary reduction for the area of the holes and also due to the high bending stresses in the angle caused by the eccentricity of the connection.

Another feature of the design, which was dependent upon the splice detail, was to make each truss and column section complete in itself. Light angles boxed in the end of each section and diagonal bracing at each end stiffened the section for handling in the fabricators' shop, for shipping and for erection.

The general plan and typical elevation of the structure as designed for welding is shown in Fig. 2. Splices are located and the sizes of chord angles and diagonal angles listed. Columns were designed for combined bending moments of 85-ft. kips and 50-ft. kips plus an axial load of 13 kips. Truss KP-38 was designed for a combined vertical and horizontal BM of 85-ft. kips and 29-ft. kips. Maximum shear at Column P was 8000 lb. which amounted to 5600 lb. per diagonal. For the $1^{3}/_{4}$ x $1^{3}/_{4}$ x $^{3}/_{16}$-in. angles this gave 9000 psi. over the gross area, or 12,400 psi. over the net area after deducting one-half the outstanding leg of the angle. For the compression diagonal the L/r ratio was 88 which gave an allowable unit stress of 13,000 psi. The angle was welded to the chord angle with 6 in. of $^{3}/_{16}$-in. fillet which is good for 10,000 lb. or almost twice the estimated load. This particular detail is elaborated upon because, had bolted construction been used, the shear loads were such that two-bolt connections for the diagonals

would have been required. Diagonals would have been heavier and the chord angles would have been 4 x 4 x $^1/_4$ angles or else gussets would have been required. For similar requirements on the existing structure the larger angles were used as details and fabrication was less expensive.

For the bolted construction, all holes for the diagonals would have been drilled or reamed to $^1/_{32}$ in. larger than the bolts which helps to keep fabrication costs up. In addition to the drilled holes, camber had to be added at the splices and the resulting truss was still not as stiff as the welded one.

Horizontal lacing angles were $1^1/_2$ x $1^1/_2$ x $^3/_{16}$-in. angles on all trusses. Both the angles and the connections to the chord angles have ample strength and weigh 26% less than the minimum size angle feasible for a bolted truss.

Inasmuch as the degree of rigidity obtainable at the intersection of the truss and column for standard bolted details is to a great extent an unknown, it has been a customary design practice to make the intersection rigid enough to resist the wind loads and then design the truss as a simply supported span for dead and live loads. Such practice does not recognize the true stress conditions and until the connections have been greatly overstressed such action cannot occur.

By designing for full continuity and making the connections rigid enough to obtain it, the design moments were reduced to a very considerable extent. Details of the intersection of the two trusses and column are shown in Fig. 4. Joint eccentricity was kept to a minimum and all details were checked for both the amount of weld and the weldability or access to the weld.

Most of the connections between the diagonals and the chord angles were overwelded as all lap joints had to be welded all around. Unless this is done, it has been found that, after galvanizing, rust streaks start at each lapped surface. Because of this, overlapping was kept to a minimum. Typical welding details are shown in Fig. 5 and include the splice detail which was made standard for all truss and column connections in so far as practicable, and the detail of a typical diagonal to chord angle connection. The box fillet weld shown has been proved, by many tests, to be as strong as the angle.

A base detail designed to fully develop the column section is shown in Fig. 6. This detail involves a total of 26 pieces and 150 lb. of steel per column and compares with a detail calling for 28 pieces and 850 lb. of steel including 122 bolts (26 of which were countersunk) which has been standard for the bolted type construction. Again this detail affords an illustration of one of the principal values of welding in structural design, which is simplicity of detail and its resultant economy of material. This particular base detail was affected somewhat by the maximum allowable width of 2 ft. 6 in. formerly discussed.

Along with the splice design, Fig. 3 illustrates the detail used to connect the intermediate trusses to the main side trusses. This connection is primarily a shear connection as the bending moment at the connection is very small.

The method of lacing the truss and column sections with four angles meeting at a common intersection with the chord angles is somewhat unorthodox and presented certain difficulties to the fabricator. However, the welding at each point was balanced about the central axis of the truss and it is believed that this method of lacing the truss contributes greatly to minimizing the warping and twisting of the truss section. All the sections, as shipped, after galvanizing, were straight and true with no visible distortion or warping.

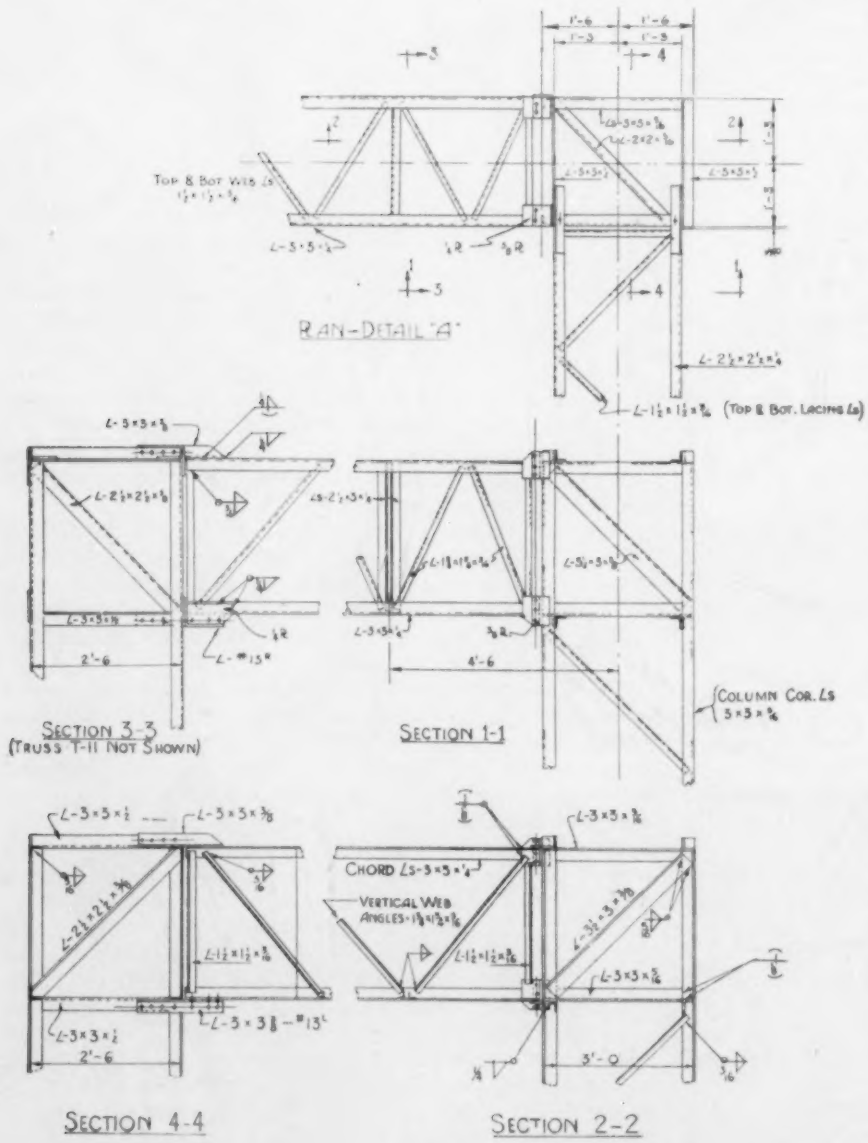


Fig. 4

Economy of the Welded Design

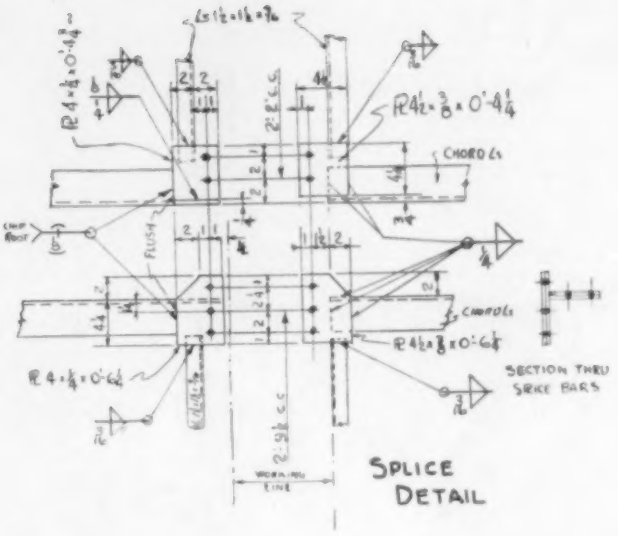
In order to make a fair estimate as to the economy of the welded design, an alternate design was prepared on the basis of bolting the structure throughout, following details and practices similar to that on the existing structure to which the addition was being made.

A tabulation of comparative sizes and weights of the various trusses and columns is given in Table 1. The following factors, in order of magnitude, are held to be primarily responsible for the reduced weight of the welded design.

(a) Simplicity and directness of connection detail.
(b) Full continuity in design, reflected in small moment requirements.
(c) Smaller size diagonal lacing angles made feasible by welding.
(d) Smaller size chord angles due to more efficient joints.

Included in the estimated saving made possible by welding is a reduction in the number of bolts required from over 3000 to about 650.

Thus, by utilizing all the advantages of arc welding that seemed practicable, it was possible to effect a saving of over 36% of the steel previously required for this type of structure. This factor alone loomed large in determining which design to use, especially so in the light of the present demands for, and scarcity of, steel. Several structures of this and other types have been redesigned for arc welding since this design was made, and in all cases, it was found possible to effect economies of from 30 to 40% in the required amount of steel.



Design and Detailing Costs

While design costs of the two types are approximately the same, it was found that detailing the welded structure was much easier and more rapid indicating a substantial saving in time and money for the design and detailing force.

In detailing the welded structure, the truss and column sections were treated first as plain welded assemblies with as much duplication as possible. Lacing angles were not located exactly so that much computation was avoided.

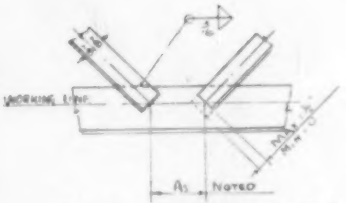


Fig. 5

Table 1—Comparative Sizes and Weights of Welded and Bolted Designs

	Bolted Design		Welded Design	
Assembly Marks and Members	Size Members	Total Weight, Lb.	Size Members	Total Weight, Lb.
Truss JO-38				
Chord angles	4 x 4 x 1/4	1640	3 x 3 x 1/4	1205
Diagonals	2 x 2 x 1/4	870	1 3/4 x 1 3/4 x 5/16	700
Connection details	....	800	....	270
Miscellaneous details	....	580	....	330
Subtotal =		(3890)		(2505)
Truss KP-38				
(Same as JO-38) plus miscellaneous details	....	540	....	300
Subtotal =		(4430)		(2805)
Truss KJ-38-17N				
Chord angles	3 x 3 x 1/4	1310	2 1/2 x 2 1/2 x 1/4	1090
Diagonals	2 x 2 x 1/4	1030	1 3/4 and 1 1/2 x 5/16	755
Connection details	....	420	....	250
Miscellaneous details	....	110	....	85
Subtotal =		(2870)	....	(2180)
Truss KJ-38-44N				
(Same as KJ-38-17N) plus miscellaneous details		570		450
Subtotal =		(3440)		(2630)
Truss PO-38				
Chord angles	3 x 3 x 5/16	1610	2 1/2 x 2 1/2 x 1/4	1090
Diagonals	2 x 2 x 1/4	1030	1 3/4 and 1 1/2 x 5/16	755
Connection details	....	800	....	370
Miscellaneous details	....	120	....	85
Subtotal =		(3560)		(2300)
Columns P and O				
Leg angles	4 x 4 x 5/16	2530	3 x 3 x 5/16	1880
Diagonals	2 x 2 x 1/4	1250	1 3/4 x 1 3/4 x 5/16	740
Intersection details	....	1150	....	730
Base details	....	1700	....	300
Subtotal =		(6630)		(3650)
Miscellaneous additional details		460		400
Total weight		25,280		16,470
	3000—5/8-in. Bolts	1,300	650—3/4-in. Bolts	450
		26,580		16,920
% Reduction = 36.4				

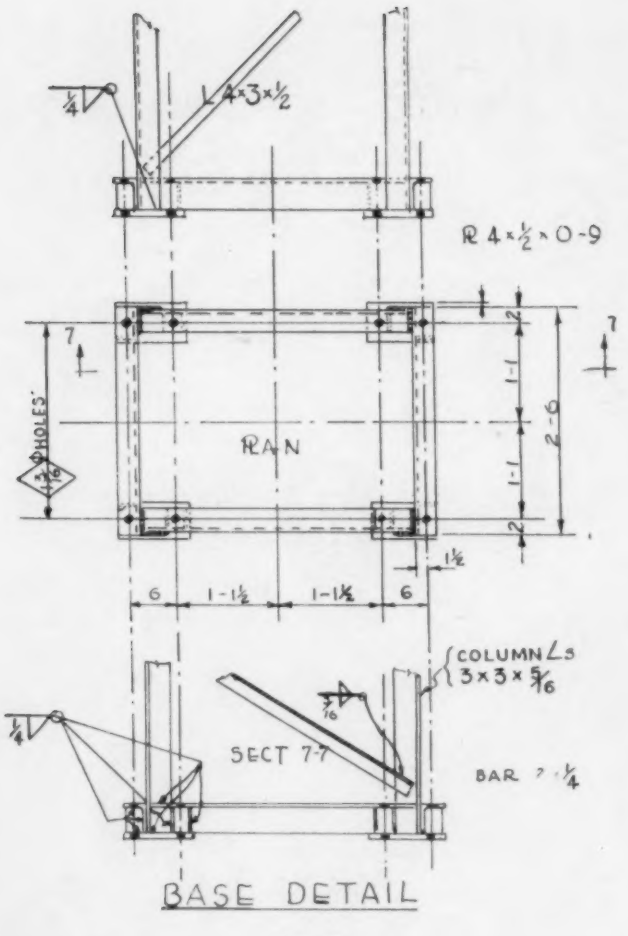


Fig. 6

The truss and column sections were then treated as prefabricated assemblies with additional details to be added and miscellaneous holes detailed on the assembly instead of detailing each piece of the truss section separately.

Fabrication Costs

Inasmuch as this was the first time that welding had been used to any extent on a structure, preliminary estimates as to fabrication costs could be little more than a guess. Furthermore, past experience indicated that regardless of how accurately preliminary costs are made, the actual cost of the fabricated steel to the customer depends upon supply and demand or the fabricator's willingness or reluctance to take the job. After due consideration, it was deemed advisable to submit to the various fabricators both the welded design and the alternate bolted design, and a request for bids on a tonnage basis for both designs was made.

Quotations received for the bolted structure were fairly consistent but the high quotation for the welded design was over 30% above the low bidder which illustrates how conditions over which the designer has no control may affect cost estimates.

For the following comparisons averages of the quotations will be used both for the welded design and the bolted. This errs somewhat in favor of the bolted design but it will affect the final comparisons very little.

As can be seen from the estimated probable breakdown of the fabricators' quotations in Table 2, there is considerably more shop labor involved in the welded design.

Table 2—Estimated Breakdown of Low Bid for Steel Fabrication

	Welded Design, Cost per Ton		Bolted Design, Cost per Ton
Steel base		45	$ 45
Cutting and shearing		15	20
Punching		5	25
Fit-up and tack weld		30	..
Welding		15	..
Shop assembly and reaming		20	..
Galvanizing		35	..
Bolts	(53 lb. per ton)	15	(100 lb. per ton) 30
Shipping		10	35
Total cost per ton		$190	10
			$165

8.5 tons at $190 = $1615
13.25 tons at $165 = $2186
Total saving in fabrication cost = $571—26%

This added shop cost was expected, but it is believed that, where a structure involves a sufficient number of duplicate trusses and a somewhat larger tonnage, the fabricator could effect a considerable saving in fitting and welding by constructing suitable jigs and fixtures. As more confidence in this type of construction is acquired, larger structures will be designed for welding, and it can be expected that fabrication costs will decline.

Erection Costs

The field erection of outdoor substations is usually done by steel erection contractors as was the case for this structure. Preliminary estimates indicated that the actual erection cost per ton would be much less than for a bolted structure. However, when considering the isolated location of the structure and the small tonnage involved, it was feared that the erection quotations would be high. When bids were received, however, it was found that the price for erecting was about 15% less than previous quotations on similar bolted structures. We can safely assume that when the tonnage of the structure ranges from 20 tons upward, the erection cost of the welded structure will be from 25 to 30% less than for a bolted structure.

Reduced erection costs can be attributed to the following advantages of the welded design:

(*a*) Comparatively few pieces or assemblies to be handled.
(*b*) Small amount of field bolting required.
(*c*) Shop assembly and match marking for easy fit-up in the field.
(*d*) Lighter weight of assemblies and increased rigidity of the members.

Table 3—Summary—All Costs (Given as Cost per Ton)

	Welded Design, Cost per Ton	Bolted Design, Cost per Ton
Design	$ 15	$ 15
Detailing	25	35
Steel fabrication	190	165
Erection of steel	35	45
Total cost per ton	$265	$260

Estimated cost of welded structure— 8.5 tons at $265 = $2252
Estimated cost of bolted structure —13.25 tons at $260 = $3445
Total saving = $1193—34.6%

Summary of Total Costs

A final cost summary of the two comparative designs based upon the previously discussed factors is given in Table 3. These costs are changed somewhat from the actual costs in order to make them applicable for all structures of the type, illustrated in Fig. 1, which involve quantities of steel ranging from 10 to 30 tons. Larger structures or quantities of steel may change individual cost items, but should not affect the comparative value of the summary.

Conclusion

In the preceding pages an attempt has been made to briefly describe an outdoor substation structure, and after considering the various loadings and limitations involved, to incorporate into the design of a particular structure all possible advantages made available by arc welding.

General design procedure has been described and basic design details which affect the entire design have been elaborated upon. Along with the design of the welded structure, a design and estimate of a duplicate structure, based on bolted construction, were made in order to make fair comparisons as to weight and cost. These comparisons have been set up in Tables 1 to 3 and they should be applicable, in general, to all structures of the type under consideration.

The total savings in tonnage and cost shown may be small for one structure, but the vital consideration is the percentage saving involved, and the total saving made possible by adopting the welded design, or similar designs for all structures of this type built by any one power company, or all such companies.

The company for which this structure was designed builds many similar substation structures each year, and by adopting the welded design for all future construction, it is estimated that from 40,000 to 70,000 lb. of steel and from $10,000 to $17,000 could be saved annually. Considering the entire industry, the total savings would add up to a substantial figure.

Furthermore, the welded construction provides a structure which will be more rigid, will have a better appearance and will involve less maintenance cost over a long period of years.

In conclusion, it might be pertinent to mention that the structure described above is the first such welded structure ever built by the company with which the writer is affiliated and that radical changes in design procedure and standards were involved. The writer acknowledges, and is grateful for, all the cooperation extended by the various officials of the company and without which the structure could not have been built.

"Welding for Victory"

By John G. Sherbo*

THE widespread acceptance of welding to increase production of war materials developed a shortage of qualified welders so that the Government found it necessary to establish training schools now known as The National War Training Schools.

* Supervisor, Welding Division, War Training School, Des Moines, Iowa.

Fig. 1—Carriage for Cutting Torch

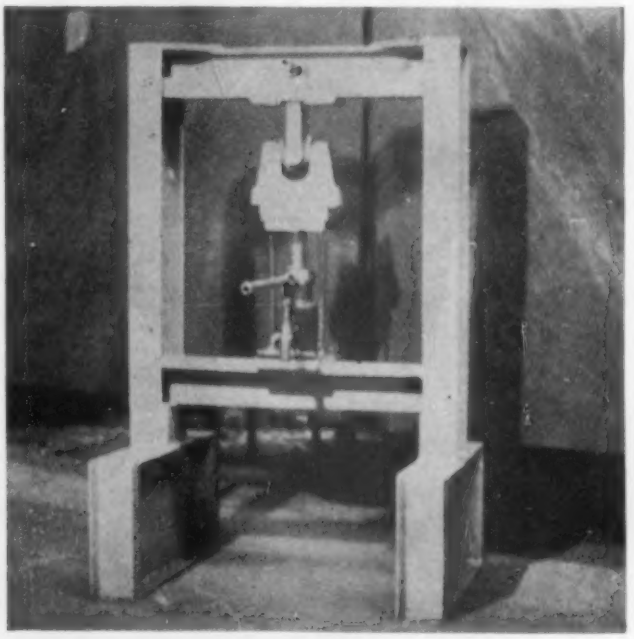


Fig. 2—Testing Jig

One of these schools located in Des Moines, Iowa, has been in operation a little over 2 yr. This school, the finest in this part of the country, is equipped with 24 of most of the standard a.-c. and d.-c. arc-welding machines and 80 acetylene stations. Acetylene gas is generated by two 500-lb. generators furnishing a never-ending supply of acetylene by one generator being held in reserve until the other is down and then automatically cutting in. This permits charging the other generator without loss of time.

The school offers courses in machine shop training,

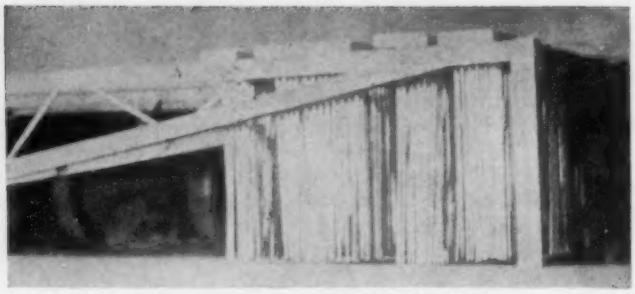


Fig. 3—Rack for Drying Electrodes

aircraft riveting and sheet metal layout, structural sheet metal work, mechanical drawing, precision measurement inspecting, radio repair work for U. S. Army Signal Corps, general arc welding, general acetylene welding and a special course in acetylene welding of light gage stainless steel.

Naturally each division has its own problems but in this article we are concerned about the problems in the welding division which were many and which required a certain amount of patience and ingenuity on the part of the school authorities. The welding shop occupies a space approximately 100 x 140 ft. on the ground floor with a 11-ft. ceiling. In spite of the fact that there are windows on 2 sides and a part of another the smoke from the coated electrodes presented a problem that was solved by building hoods over the welding tables with ducts leading to a large suction fan and conducted outdoors. While this is not the most satisfactory method since it does not draw the smoke at the source of generation it does prevent the shop from filling up.

Each process of welding is a separate course but arc welders are taught the use of the acetylene cutting torch in preparing beveled plates for practice welds. A carriage shown in Fig. 1 operated by hand-feed built by one of the instructors is capable of making a smooth cut requiring only enough grinding to take off the feather edge of the cut. The testing jig shown in Fig. 2 is also a product of the school. The welding shop built the frame of scrap I-beams and channel iron. We found it was impossible to purchase a hydraulic jack so the machine shop built a 15-ton hydraulic jack that gives us the lifting power necessary to make the guided U-bend tests. By these tests we determine the grade an arc or acetylene student is given on his certificate on completion of the course. Stainless steel students are given the same test required by the Army and Navy on 16- and 20-gage material. Students in the arc and general acetylene classes for the most part work on practice welds in all positions on types of joints commonly used in industry. Our supply of welding rods consist of practically every make of rod thereby affording the students a wide scope of experience.

The school started out with 8 arc welding booths and 16 acetylene stations. As the enrolment increased, the advanced students under the supervision of their instructors built additional booths and welding tables, likewise welding rod racks, iron racks and other incidentals to the school. This gave them an opportunity to put into use the skills they had developed in their practice welds. We find it stimulates interest by permitting students to weld broken metal parts and to build useful articles as mentioned above.

Some time ago we experienced some difficulty in procuring welding electrodes. Some damaged electrodes were available which we purchased rather than face a possible curtailment of the classes and thus break the steady stream of graduates going to work in war industries. We found about 50% of these electrodes were so badly damaged by being exposed to water that the rods were stuck together in a solid mass. In breaking them loose the coating tears off one rod and sticks on others. Since it was impossible to use them in that condition, we started reclaiming them by removing the damaged coating by boiling them 30 to 40 min. in a solution of lye and water. We find that 1 can of ordinary household lye is sufficient to cleanse 150 lb. of electrodes. After the rods have boiled until the coating has dissolved they are dumped over a drain and rinsed off with a water hose. We use some of the smaller sized rods as bare rods. The others, including $^{5}/_{32}$ in. and larger, we recoat by dipping in Pasco's Dipcote, a flux for coating welding electrodes, and hang to dry over 2 horizontal bars as shown in Fig. 3. The drying process requires 4 to 5 hr. One dipping makes a good straight polarity rod. Where a reverse polarity rod is desirable it requires an additional dipping after the first coating has dried.

The flow of graduate welders is continuous, with hundreds of them finding employment in the shipyards, aircraft plants, arsenals and, in fact, everywhere welding is used. Our records show that 96% of those who complete the course are absorbed by industry. Even many of those who for reasons were unable to complete the course found jobs as welders. In recent months there has been an increased influx of women students eager to do their part in the war effort. Most of them take the special acetylene course in light gage stainless steel welding with a few taking the general courses in acetylene and arc welding. It is anticipated as more and more men enter the armed forces the percentage of women welders will correspondingly increase.

One-Piece Press Stand Made by Flame Cutting and Welding*

By H. E. Berg†

ONE of the principal advantages of welded fabrication is the opportunity for simplification of design which this method affords, particularly when redesigning a structure formerly made by other methods. An excellent example of this, found in the fabricating shop of DeBourgh Manufacturing Co., Minneapolis, is the press stand shown in the accompanying photographs. This part is formed of a single piece of 1/4-in. plate, flame cut and formed like a paper box, then welded at four mitered corners. It would be difficult to imagine a simpler procedure, both as to design and fabricating method, than this which produces a rigid stand, pleasing in appearance.

In arriving at the design for this piece the company had the option of several types of fabrication, but selected the mild steel unit-type construction as best suited to the shipboard service in which these laundry legger press stands are used. A construction made of angles, bars and plates would have been unsightly and heavy, whereas the single flame-cut piece is light, and is enhanced by the

* Manager, DeBourgh Mfg. Co., Minneapolis, Minn.
† Photos supplied through the courtesy of the Air Reduction Sales Co., Lincoln Bldg., New York, N. Y.

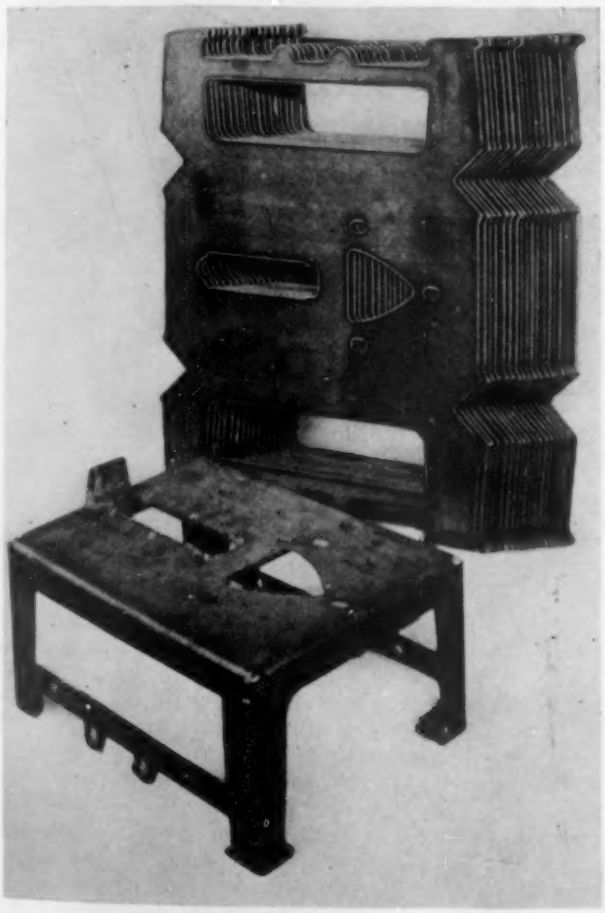


Fig. 1—One-piece Monolithic Press Stand After Welding, Formed from Single Flame-cut Plate Shown in Background

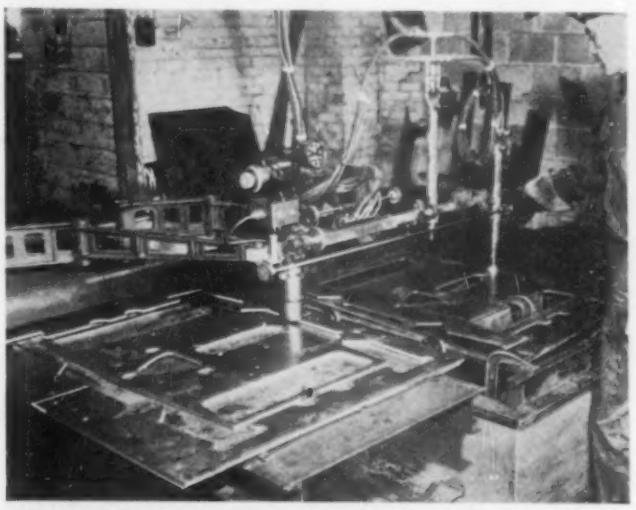


Fig. 2—A Three-piece Template, Lined on Working Edges with Adhesive Tape, Is Used with Magnetic Tracer on the Planograph Cutting Machine

Fig. 3—After Flame Cutting, Plate Sections Are Bent Like a Paper Box to Assume the Final Shape

tapered legs and graceful contours which are characteristic of flame-cut, welded fabrication.

The stretch-out template was made in the following manner. A layout was made on 16-gage steel, including all of the center openings, even to the slotted bolt holes. This was cut to shape by shearing, and mounted on half-inch studs to provide clearance from the worktable when used as a preliminary cutting template. This template was then used as a master for the flame cutting of a working template from $^3/_8$-in. plate, heavy enough to offer attraction to the magnetic tracing device employed in quantity production of flame-cut parts. The working template was then clamped to the worktable of a planograph cutting machine, and the production cutting was done with high-speed cutting tips. These tips enabled cutting of the $^1/_4$-in. plate to be done at the unusually high speed of 35 in. per minute. Each piece requires 28 lineal feet of cutting, involving eight separate starts.

After cutting, the plate section is formed on a power bending brake as shown in Fig. 3. Four bends bring the flat plate into final shape. The monolithic structure is completed by the welding of four simple miter joints between the end apron and legs on both ends. Foot pads and a bracket are welded on to finish the assembly. The rapidity of this sequence of operations is shown by the fact that DeBourgh received the subcontract order on a Tuesday and was able to deliver the first finished press stand on Thursday of the same week.

Surface Treatment of Aluminum-Alloy Assemblies Prior to Spot Welding

By H. O. Klinke*

PRESENT-day general practice throughout the aircraft industry is to treat the surface of aluminum-alloy sheet and formed shapes prior to spot welding by cleaning each part by some mechanical means or by immersing each part of an assembly individually in a series of solutions. These solutions are usually four in number and consist of a degreasing solution, a hot water rinse, an etching solution and a hot or cold water rinse. These detail parts are then dried by air blast.

The sequence of operations generally used in an aircraft plant in fabricating the various assemblies which are then joined together into larger assemblies and finally make up the plane itself on the final assembly line is therefore interrupted by the necessity for surface treatment of the individual parts prior to assembly. If this surface treatment occurs prior to forming, stamping or machining of the detail parts, then they become coated with drilling and forming compounds and probably become reoxidized due to the long delay before spot welding. It is therefore necessary to form the various detail parts, load them in a jig, button them together with skin tights or other temporary fastening, remove from the jig, remove fastening, process through the above cleaning sequence, reassembly in the jig, fasten together again, remove from the jig, spot weld, remove temporary fasteners and then rivet. By examining the above sequence of operations, it will be noted that the parts must be assembled and disassembled several times and must be transported back and forth through the shop causing considerable duplication of effort. It has long been considered desirable to surface treat aluminum alloys in assembled form and this paper concerns itself with a series of tests made at Republic to determine the possibility of doing this. This series of tests duplicates in many respects those first carried out at Northrup Aircraft, Inc., and reported by Mr. T. E. Piper in THE WELDING JOURNAL for October 1942. Full credit is due the above concern for carrying out this initial work on the cleaning of assemblies.

The sequence of operations if assemblies can be cleaned would be as follows: Fasten together the parts in a jig either with temporary fasteners or by permanent holding rivets, remove from jig, clean, spot weld and finally if necessary, replace temporary fasteners by rivets. It will be found that many assemblies having relatively few rivets can be riveted prior to spot welding since the restraint caused by these rivets will not cause buckling or warping if the proper spot welding procedure is used. We have successfully concluded an extended series of tests with a commercial solution consisting of phosphoric acid containing a degreasing agent and a wetting agent. Subject to the limitations given below, this solution may be used to clean assemblies and our experiences both during the test work and on an extended production run indicate that the faying surfaces to be spot welded in the assembly are adequately cleaned, surface oxide removed, and uniform and consistent spot welds well within the Army minimum requirement are obtained.

The solutions necessary for assembly cleaning are as follows: a degreasing solution, hot water rinse, assembly etching tank and a cold water rinse. These tanks are placed in proper relationship to one another and a suitable conveyer or monorail basket setup provided so that the heavy assemblies may be easily processed through the tanks. The phosphoric acid solution is used at room temperature in a wooden tank at a nominal concentration of 50%.

The following list of questions and answers will outline in a concise manner the various aspects of this problem and the corresponding results of our tests.

(1) What Are the Criteria for Satisfactory Welds?

Army Air Corps Specification No. 20011C gives minimum shear values for individual spot welds in various gages for several metals and 80% of these single spot values times the number of spots are the strengths used by aircraft designers. It would seem adequate and satisfactory therefore to use such surface preparation methods as would consistently yield at least the above shear values plus a safety margin and which would give maximum production facilities in the shop.

(2) What Surface Conditions Are Necessary to Produce the Weld Strengths Noted Under (1)?

Considerable work has been done in recent years on the determination of optimum surface conditions for

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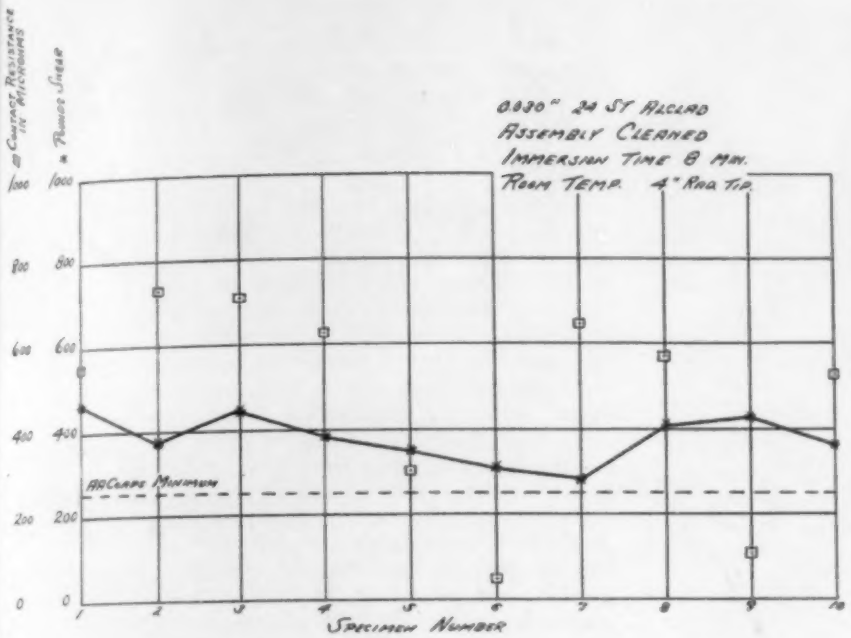


Fig. 1

spot welding and the basic assumption which pervades most of the published work is that a low and a consistent contact resistance is essential for good welds as defined under (1) above. The value of this low resistance is variously taken as from 10 to 100 microhms with the low value considered the most desirable. When assemblies are cleaned with this phosphoric acid solution, the interface resistance will vary from 30 to 1000 microhms. Figures 1 and 2 show the contact resistance of assembly-cleaned specimens of 24ST Alclad for two thicknesses, 0.064 to 0.030 in. The specimens were of standard type as given in the Air Corps Specification noted above and were held together by small bolts so that the cleaning solution was forced to creep into the faying surfaces. It was shown that the solution did penetrate the full width of the specimen. These specimens were then pulled in the manner of the standard shear test and the breaking loads were in excess of the specification minimum. The individual shear values bore no relationship to the contact resistance in that a low surface resistance was as likely to give a high as a low shear value and vice versa. The machine setting was the same for all specimens and was set up by taking a random group of specimens and adjusting the welder settings until the required minimum shear values were exceeded. The maximum width restrictions as to faying surface that the phosphoric acid solution will penetrate was not determined but the flange widths specified in the A.W.S. Tentative Spot Welding Standards are satisfactory. Figures 3 and 4 show the shear values for a number of assembly-cleaned test specimens taken each day over a month's time in which a number of sheet surface conditions were encountered. These curves show a consistency comparable to that obtained with detail cleaning using chemical means. A few specimens were examined radiographically and the nugget shape was compared to that obtained with detail cleaning. No difference could be detected. No surface cracking was experienced and interior cracking was comparable to that obtained on detail cleaning. It would therefore seem that the contact resistance may vary over quite wide limits and yet at one machine setting all spots will be above minimum and have good appearance and consistency.

(3) *Tip Life Using Assembly Cleaning*

No specific tests were made of the tip life that may be expected as compared to detail cleaning but general observations made during the three-month production run made of some 25 assemblies indicates that a tip life at least as good and very possibly better may be realized.

(4) *Effect on Anodized Parts During Assembly Cleaning*

No anodized parts may be immersed in this solution since the coating will be stripped. Anodized parts such as brackets, etc., that are a part of assemblies must be left off but usually the assembly and manufacturing sequence may be so arranged that the anodized parts can be attached after the part has been cleaned and welded. It would be very desirable if anodized rivets could be used to hold an assembly together during cleaning and welding since these rivets could remain in the assembly instead of using skin tights which must then be removed and replaced with rivets. This entails transporting the part back to the manufacturing department concerned

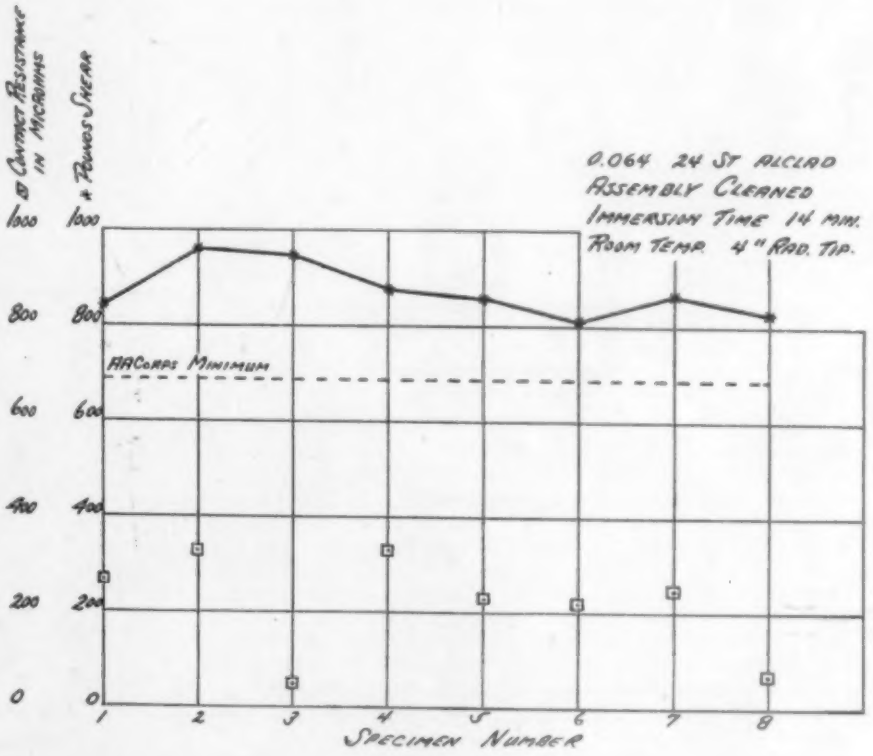
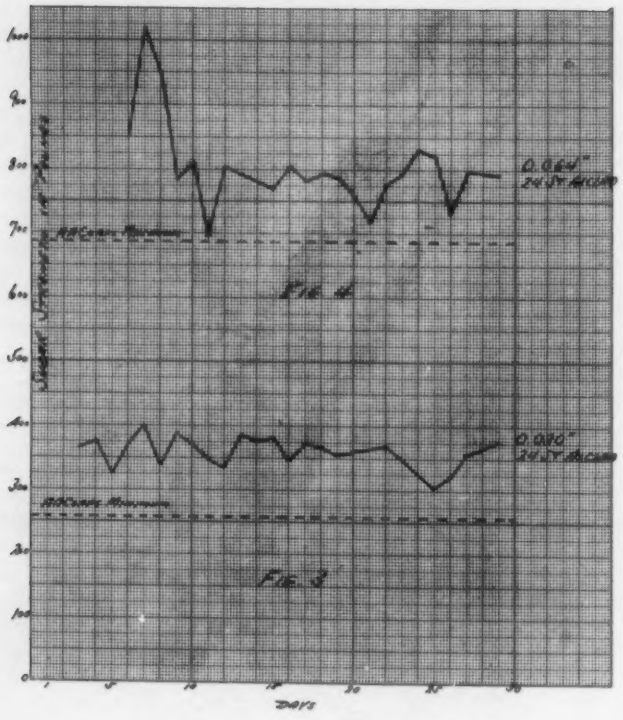


Fig. 2



and is wasteful of both shop and jig time. Upon investigation, it was discovered that in driving an anodized rivet the coating is split in such a manner that its effectiveness as a protective coating is practically nil and hence immersion as part of an assembly has no further deleterious effect. It must be remembered that, in general, the fabrication procedure for a composite assembly which is both riveted and spot welded should call for the spot welding to be done first followed by riveting. This follows from the general rule that any assembly having an operation involving a thermal cycle should be performed before the part is restrained by any other fastening operation since in the reverse procedure buckling is apt to occur. However, the use of a relatively few tack rivets in lieu of skin tights is admissible and these rivets then remain in the assembly obviating the need to return the part to the manufacturing department. This procedure is a major factor in realizing the time saving inherent in assembly cleaning.

(5) *Type of Structure Tested*

Among the assemblies that may be welded by this cleaning process are cowl, fuselage and wing doors, miscellaneous fuselage and wing subassemblies and a wide variety of other similar parts.

(6) *Economy to Be Derived from Assembly Cleaning*

The Economy or the saving in man-hours to be obtained through the use of assembly cleaning is considerable and fully warrants a thorough study of each job as to whether or not it is applicable to such a procedure. One very important result derived from an assembly-cleaning procedure is that a straight-forward production line assembly system can be maintained in that no parts need retrace their path in the shop as must be done in detail cleaning. This factor is of considerable importance as a great deal of time is lost when parts are routed to and fro in the shop from place to place.

A study was made of several representative assemblies with a view to finding an exact time comparison between detail and assembly cleaning.

(*a*) *Side Section—Secondary Cowl Assembly.*—This assembly may be tack riveted together in the jig, removed and cleaned, then spot welded and sent to finishing. The time saved is 0.3 hr. per assembly with an estimated 0.5 hr. additional saved through transportation and loading and unloading time.

(*b*) *Assembly Wing Fillet.*—This part may also be tack riveted, cleaned and welded with a saving of 0.6 hr. per assembly together with an additional saving of 0.5 hr. in transportation and handling.

The above assemblies are representative of many to be found in aircraft construction and when the savings are totaled for all spot-welded construction, a very sizable saving results.

Conclusion

From the above data it may be concluded that assembly cleaning yields welds that are adequate and consistent well within the Army Air Corps Specification relating to spot welding and that a very considerable economy results from such cleaning procedure. It is believed that the test and production run reported above adequately show that this process will effectively aid to increase production of aircraft now so vitally needed.

The writer desires to extend his appreciation to the management and his co-workers at Republic for their cooperation and assistance in this work.

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(*Continued on page 623*)

The All-Welded 5400-Hp. Diesel-Electric Freight Locomotive*

By John H. Hruska†

Introduction

SINCE the fateful day of Pearl Harbor, all branches of modern transportation in the United States have been overwhelmed with a volume of passenger and freight traffic hitherto unknown in the annals of industrial progress in any country. Every phase of the three principal types of transportation services was affected by the impetus of these events: Aerial as well as maritime cargoes have overnight reached unbelievable proportions, while America's railroads were at the same time expected to haul not only scheduled trains but to move troops and defense matériel commensurate with the Nation's determined war efforts. This job required the utmost in tonnages to be moved, speeds to be maintained besides greatest versatility of motive power, which combined requirements simply could not be expected of the available conventional steam engines.

The Diesel-electric streamliners in passenger service have made history by their faithful grueling mileages accumulated daily at high-speed schedules over practically all leading railroads, while the same kind of motive power has very definitely proved its operating economies in continuous yard switching service. This superiority over steam locomotives spurred the efforts toward the development of such power equipment, which could develop the highest possible tractive effort and attain speeds up to 70 or 75 m.p.h.—and do it economically for nearly 24 hours a day, seven days per week. In order to achieve this goal, all operating experiences were scrutinized before a definite design and ultimate construction of the first "universal" Diesel-electric freight locomotive became realities. The initial units were admittedly experimental, but improved production locomotives were built and delivered in considerable numbers within the year, which have received immediate endorsements by the railroads, and which have warranted an A-1-A priority rating by the War Production Board for their significance in defense transportation.

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Material Considerations

In the early stages of development, it was readily evident that a fully utilitarian high-speed freight locomotive of the Diesel-electric type must operate under any atmospheric conditions, ranging from some 120° above to as low as 40° and perhaps even 60° below zero. Actual surface temperatures of locomotives used in Pacific and southwestern desert areas were recorded to unbelievably high values, but metallurgically greater concern must be expressed over the resistance of various materials to impact stresses at very low temperatures. Some doubt has been voiced by adherents to conventional steam power as to the importance of low temperatures in actual service conditions. Perhaps the high percentage of castings together with the heavy masses required in their construction is the major reason for this attitude. Recorded experiences of northern and western railroads with steam locomotives indicate definitely a higher frequency of material failures in extremely cold weather. In contrast, not one failure of this origin has ever been reported with welded car bodies nor welded crankcases after more than 100 million cumulative mileages on high-speed Diesel-electric streamliners built by E. M. D. In order to justify this consideration, the author has made a study of prevailing low temperatures in those territories, where Diesels are expected to render uninterrupted service. This task included preparation of a survey from the records of the U. S. Weather Bureau by compiling the lowest temperatures of the arbitrarily

Table 1

U. S. Weather Bureau Station	Railroad Service	Lowest Temperatures, ° F., for Year 1900	1910	1920	1930	1940	All Time Lowest, ° F.
Duluth, Minn.	Great Northern / Northern Pacific / Southern Line	−22	−22	−25	−28	−22	−41
Hallock, Minn.	Great Northern	−37	−39	−39	−44	−31	−51
Moorhead, Minn.	Great Northern	−26	−28	−35	−29	−23	−48
Eau Claire, Wis.	Chicago & North Western	−23	−32	−30	−30	−21	−40
Williston, N. Dak.	Great Northern	−41	−40	−37	−28	−26	−49
Bismarck, N. Dak.	Northern Pacific	−33	−37	−32	−28	−26	−45
Kalispell, Mont.	Great Northern	−19	−22	− 8	−23	− 7	−34
Miles City, Mont.	Milwaukee	−16	−29	−31	−31	..	−49
Pocatello, Idaho	Union Pacific	−15	−15	− 3	−22	− 2	−22
Lander, Wyo.	Colorado & Southern	−30	−32	−19	−39	−23	−40
Yellowstone, Wyo.	Union Pacific	−25	−20	−25	−34	−42	−42
Cheyenne, Wyo.	Colorado & Southern / Union Pacific	−18	−10	−14	−30	−19	−38

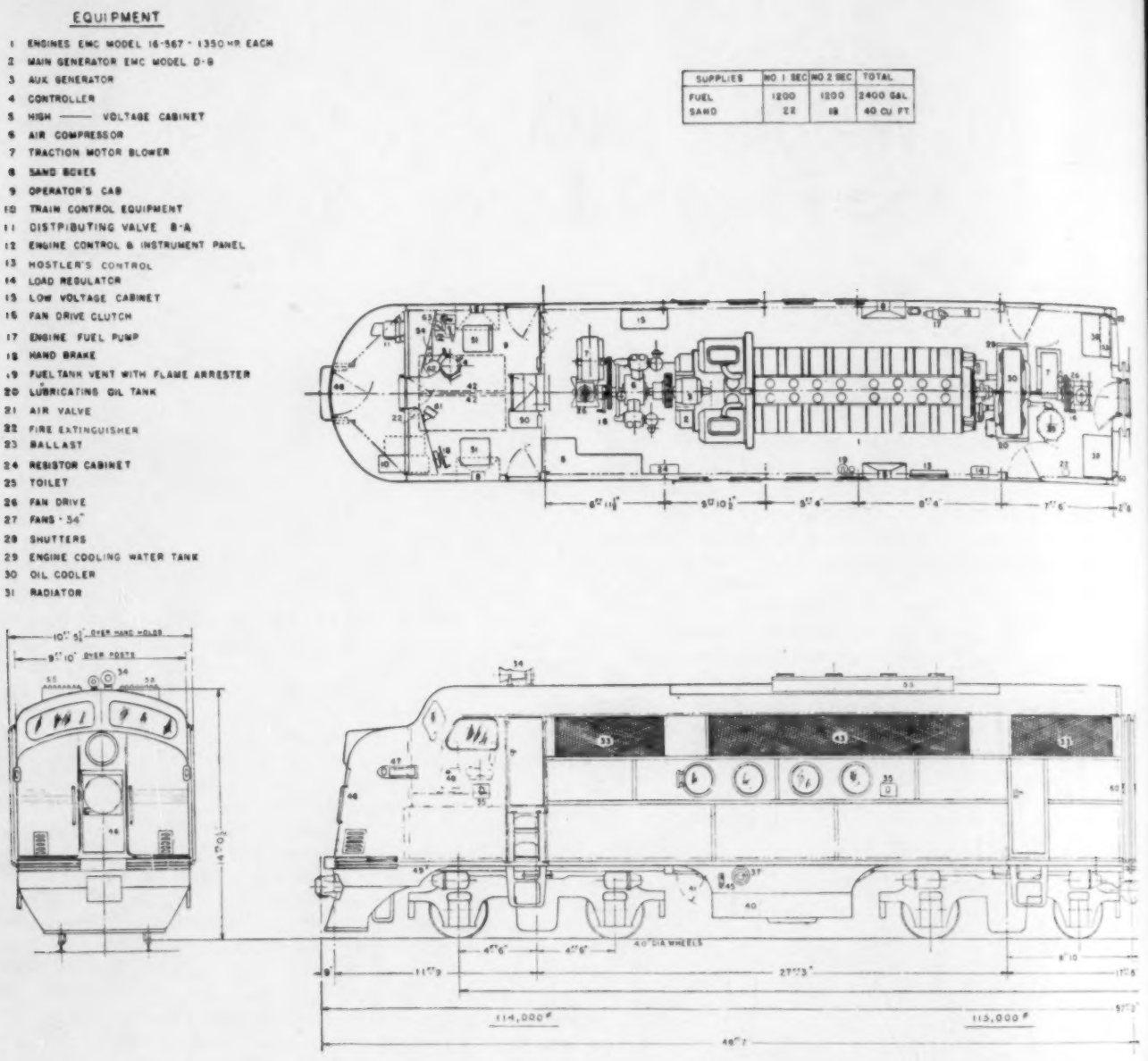


Fig. 1—Sketch Showing First Two

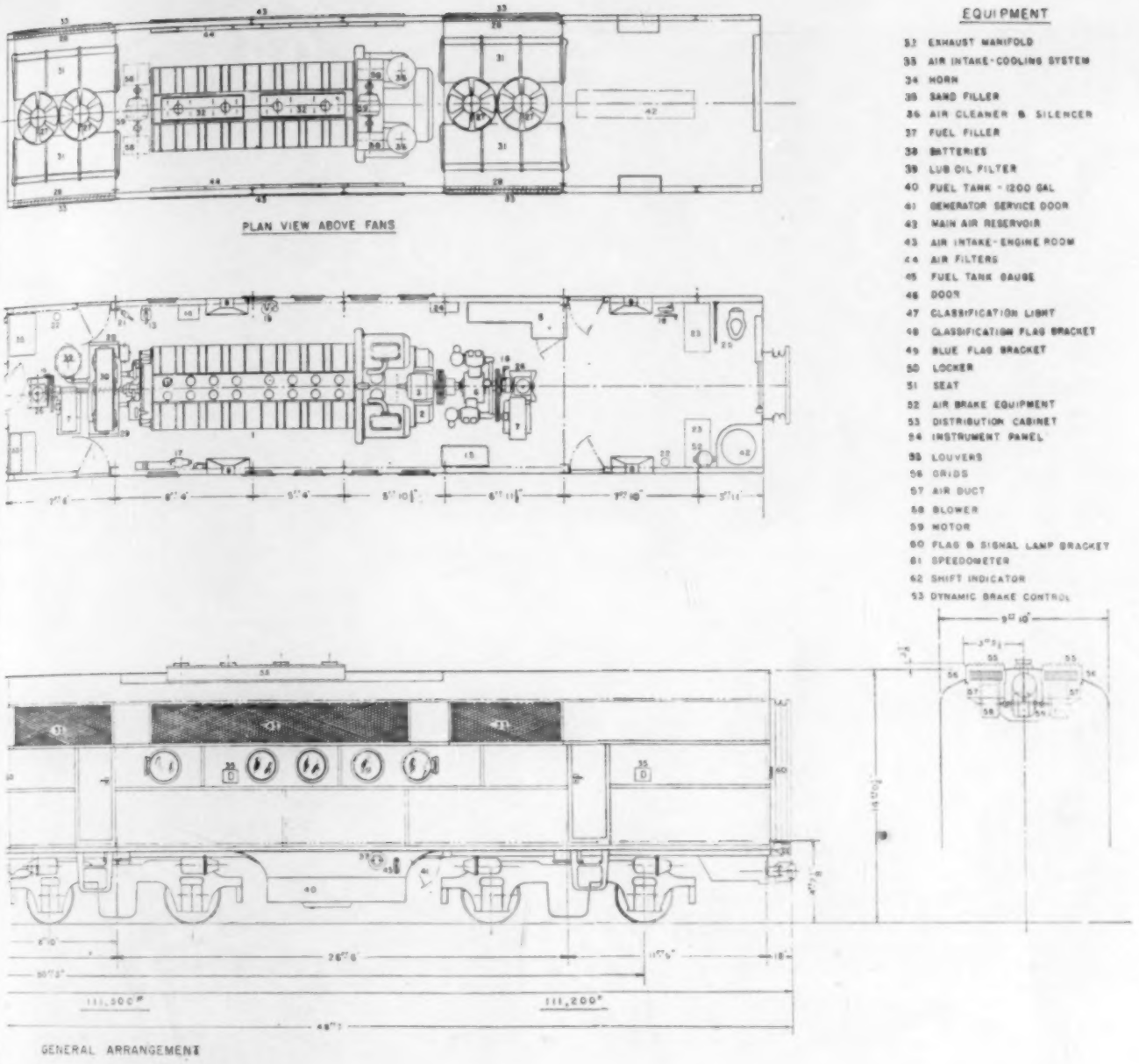
selected years of 1900, 1910, 1920, 1930 and 1940. Table 1 summarizes these figures.

The official minima for the stations mentioned in Table 1 were exceeded in 1936 by temperature readings down to 60° below zero in Riverside, Wyo., within the Rocky Mountains region. It is interesting to note that only Diesel-electric equipment maintained railroad operations, while steam locomotives simply froze up. Similar experiences have been freely admitted by operating personnel in other sectors as far south as Nevada. It is felt, therefore, that the selection of materials, joints and auxiliary equipment for highly available motive power units should make allowances for decreases of impact resistance to as low as 60 below zero. This thought has been incorporated into the engineering and control tests of all important parts of the new locomotive with fully accountable returns in safety and availability for all atmospheric eventualities.

General Description of the Locomotive

Looking back upon the frequently cited steam monsters as the 2-10-10-2 locomotive of the Virginian Railroad or the 2-8-8-4 freight locomotive of the Northern Pacific, the new E-M Diesel-electric locomotive represents a very decidedly radical departure. This is true in regard to external appearance as well as to the construction of its power plant and other mechanical equipment. A sketchy general description of the many innovations from time-honored practices will shed the first light upon the many reasons why welding was utilized so generously in the assembly of the final product.

Referring to drawing in Fig. 1 it is obvious that the locomotive is actually a multiple of four units so designed, that all may be operated from control stations in the engineers' cab of the streamlined nose of the leading or both ends. The first alternative (with one streamlined unit only) permits road operations in but one direction, whereas the adoption of units with control cabs on both ends (i.e., the first and fourth unit) eliminates the necessity of turning the entire locomotive at the terminal. Figure 3 depicts the first application; Fig. 2, shows the second possibility. Both are rated at a total of 5400 hp. The units or sections are ordinarily known as cab unit, A, B and C sections. Each unit or section is powered with a 1350-hp. Diesel engine of General Motors two-cycle type, which engine is directly coupled



Units of Freight Locomotive

to a 600-v. d.-c. generator in addition to a three-cylinder, two-stage Gardner-Denver air compressor. The generator of each unit supplies electrical energy to four type D-7-k direct current motors also developed and built in the shops of Electro-Motive Div. The potential economy of multiple units is evidenced by advantageous flexibility over ordinary steam power. Thus, it is possible by a few uncoupling manipulations to change the large 5400-hp locomotive into a single 1350-hp., double or 2700-hp., and triple or 4050-hp. combination. This advantage is rarely of interest in these days of exceedingly heavy traffic, but it will undoubtedly become a feature when normal freight schedules are resumed. It appears that the two-cab 5400-hp. combination has some attraction, because it is easy to split the same into two 2700-hp. units or a 4500-hp. and one 1350-hp. plant, both furnishing motive power to two trains. If a railroad operates two or several complete locomotives, still other combinations are feasible, thereby adjusting efficiently motive power to varying traffic conditions without sacrificing mobility of each unit. Inasmuch as the nominal maximum speed can be raised to a rated top speed of 80 m.p.h., such split units may haul heavy freight tonnages at relatively low speeds, while the balance may operate without even a simple adjustment in passenger service. These reasons together with the remunerative operations and mechanical ease of control were certainly some of the reasons for the immediate response especially by those railroads, which did anticipate operating difficulties.

In Table 2 there are summarized the first "educational" orders placed by several railroads, after the original 5400-hp. demonstrator operated 83,764 miles on twenty Class 1 railroads in 35 states under all imaginable conditions, i.e., from sub-zero to 115° above, as well as from sea level to 10,000-ft. elevation. Although these performances surpassed any riveted and cast steam locomotive thus far built, the fundamentals governing the all-welded construction of the new Diesel-electric included more power and actually less weight for the complete four-unit locomotive. This is best demonstrated by a comparison of the complete 5400-hp. combination and a 2700-hp. split on the basis of tractive effort (in pounds) *vs.* speed (in m.p.h.). Analysis of this problem indicates that the starting tractive force of the new four-unit combination is 220,000 lb., while such famous monsters as the Northern Pacific's freight steam locomotive was rated at 153,300 lb. and weighing 1,116,000 lb. against

Table 2—E-M Diesel-Electric Freight Locomotives Delivered in 1941 and 1942

Purchaser	R.R. Locomotive Serial No.	Month and Year of Complete Delivery	Number of Units With Cab	Number of Units Without Cab	Total Hp. per Locomotive
Southern Railway	6100	May 1941	2	2	5400
	6101	July 1941	2	2	5400
Great Northern Railway	5700	May 1941	1	1	2700
	5701	June 1941	1	1	2700
	5900	Oct. 1941	2	1	4050
Chicago, Milwaukee, St. Paul & Pacific	40	Oct. 1941	2	2	5400
Western Pacific	901	Nov. 1941	1	3	5400
	902	Dec. 1941	1	3	5400
	903	Jan. 1942	1	3	5400
Denver & Rio Grande Western	540	Jan. 1942	1	3	5400
	541	Feb. 1942	1	3	5400
	542	Feb. 1942	1	3	5400
Atchison, Topeka & Santa Fe	100	Aug. 1941	1	3	5400
	101	Aug. 1941	1	3	5400
	102	Sept. 1941	1	3	5400
	103	Sept. 1941	1	3	5400
	104	Nov. 1941	1	3	5400
	105	March 1942	1	3	5400
	106	March 1942	1	3	5400
	107	April 1942	1	3	5400
	108	April 1942	1	3	5400
	109	May 1942	1	3	5400
	110	May 1942	1	3	5400
	111	May 1942	1	3	5400
	112	May 1942	1	3	5400
Total as of May 31, 1942			29	66	128,250

923,000 lb. for the Diesel. Simple mathematics proves that the latter weighed 17.3% less than the steam locomotive, with an increase of 43.4% in tractive force. Some additional information on the dimensions, weights and capacities are tabulated below:

Number of units	4
Total length	193 ft.
Max. width over posts	9 ft. 10 in.
Max. width outside grabhandles	10 ft. 7 in.
Height above rails	14 ft. 1 in.
Number of wheels per unit	8
Wheel diameter	40 in.
Rigid wheel base of trucks	9 ft. 0 in.
Weight of cab unit, completely loaded	230,000 lb.
Weight of units without cab, completely loaded	228,500 lb.
Fuel oil capacity per section	1,200 gal.
Lubricating oil capacity per section	185 gal.
Cooling water capacity per section	245 gal.
Boiler water capacity per section	600 gal.
Sand capacity per section	16–22 cu. ft.

The All-Welded Car Body

Static and dynamic loading of the car body of each locomotive unit is based on principle governing modern bridge construction. Supported in two geometrical planes through the centers of the bolsters—this distance being 27 ft. 3 in.—the design of the framework approaches somewhat the construction of the already-mentioned Diesel-electric streamliners. Working stresses dictated several deviations and thus the car body is not only shorter but appears to be sturdier and less "elastic." The smooth-riding properties of the high-speed passenger units have been an incentive even in the engineering of the freight units. The new units are equipped with substantially a very similar type of helical and elliptic springs, which are intended for comfort to the operating personnel.

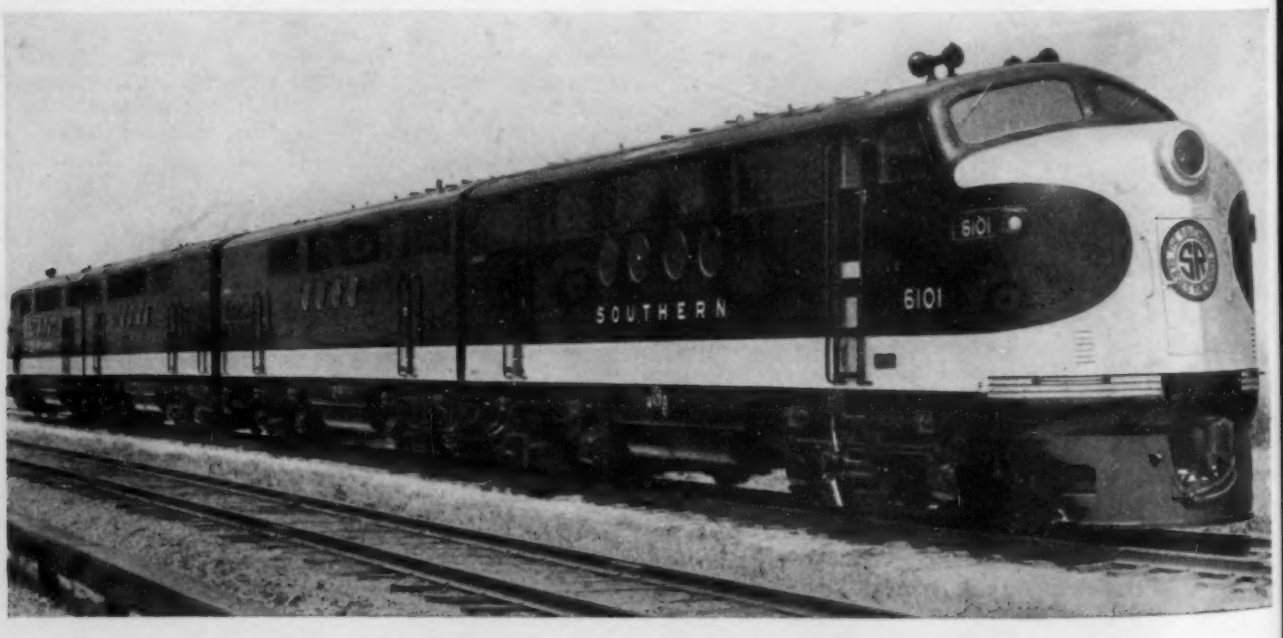


Fig. 2—A 5400-Hp. Four-Unit Locomotive Ready for Service

The design features are shown in Fig. 4, which illustration gives some conception of the major parts of the car-body framework. This "skeleton" may be used in the making of an A, C or D unit, i.e., without a cab. The latter is shown in Fig. 5 as a semi-finished front portion of the locomotive.

The principal parts of the car body are prefabricated and consist of: (*a*) underframe construction; (*b*) front-end framing; (*c*) rear-end framing; (*d*) side frame, left; (*e*) side frame, right; (*f*) roof framing; (*g*) roof hatches; (*h*) outside paneling.

(*a*) *Underframe.*—All major mechanical equipment—like the powerful Diesel engine, the generator, the compressor, etc.—is mounted directly to the underframe. A view of the upper side of this frame is presented in Fig. 6. The loads are carried primarily by a center sill, side sills and other suitable supports. In addition to these

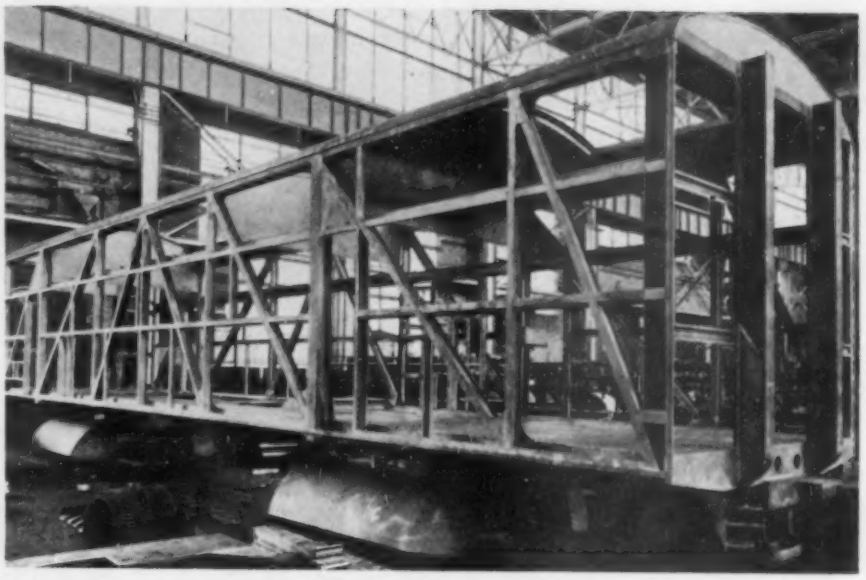


Fig. 4—Side View of Car Body Before Any Equipment or Paneling Has Been Installed

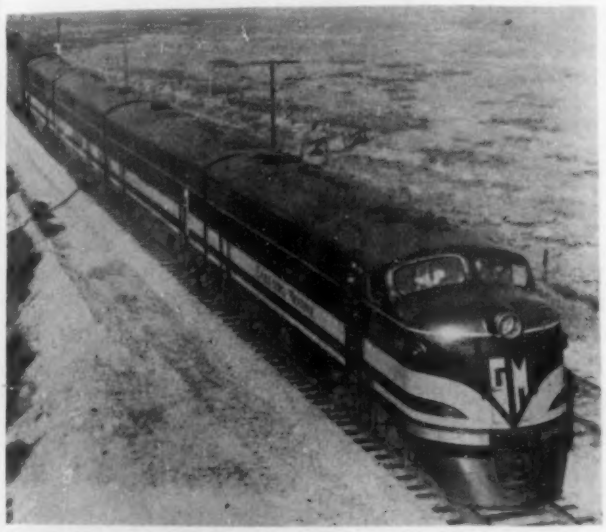


Fig. 3—The First 5400-Hp. Diesel Electric Freight Locomotive on Trial Run

loads considerable weight is brought about by rather large, also welded, tanks for fuel oil and water, which are ultimately integral parts of the frame. A $^3/_4$-in. bottom plate in front and in the rear of the base adds, of course, to the rigidity of the quite intricate structure. Before final assembly, substantial coupler pockets are welded to both ends of the underframe.

(*b*) *Front-End Framing.*—Streamline appearance has become a recognized symbol of many modern products of our industries. From cars to locomotives, this requirement combined with economical performance is a standard demanded today by private purchasers or directorates of the largest railroads. In recognition of this demand, the leading front (or sometimes even the last) units of the new freight locomotive have been arc welded so as to resemble the now popular nose of the Diesel-electric streamliner or high-speed passenger units. As a safety feature, the external smooth surface of gage 11 or 12 steel sheet is supported by a very massive construction. Collision posts of 5- x $1^1/_2$-in. cross section are securely welded on both ends into the structure. Stiffening angles and channels (made of gage 7 steel plate) are welded wherever necessary, which together with a sturdy base plate assure anticollapsing deformation if a front-end collision should occur in service. Most of the welded joints are $^3/_{16}$ in. for the stiffeners, but $^1/_2$ in. for the heavy collision posts in order to assure secure fastening.

The actual operating controls center around a roomy engineer's cab, which is built somewhat over the front bolster. Of all sections of the four units, it has been given intentionally the highest floor level above the rails, thus affording maximum visibility for safe handling on the road. The operator has easy access to a controller,

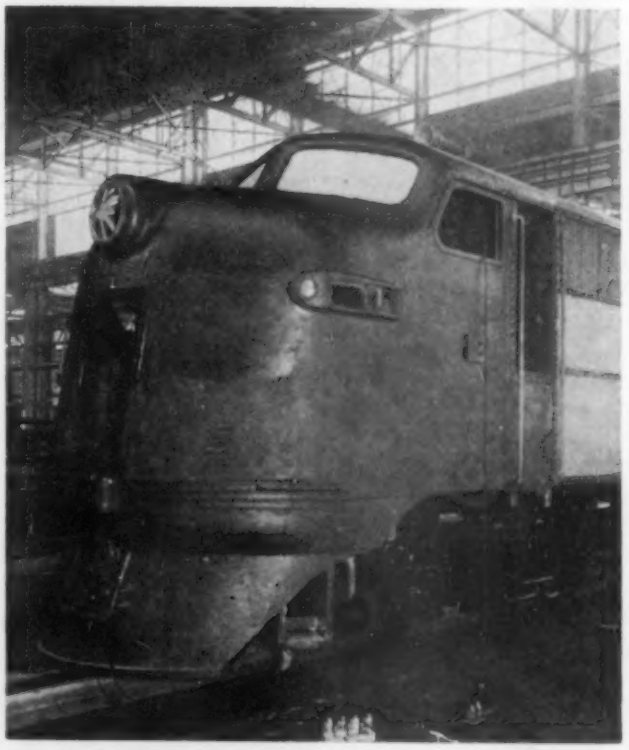


Fig. 5—The Nose of the Cab Unit After Welding, but Before Painting

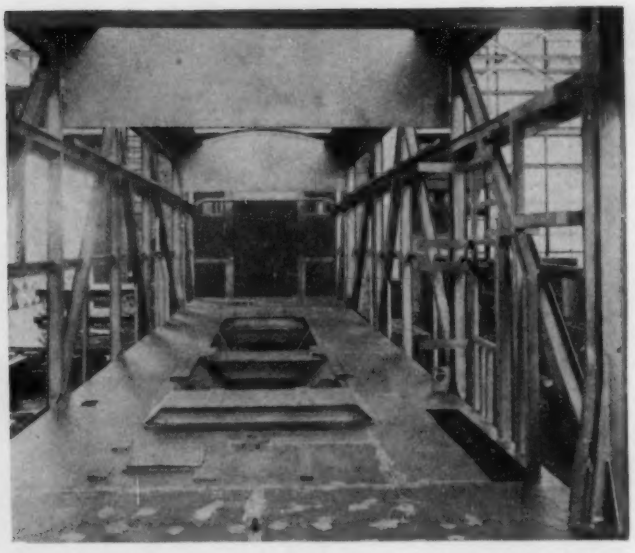


Fig. 6—Inside View of Car Body Showing Top of Underframe with Openings for Engine and Generator

reversing lever, brake equipment, light switches and all indicating instruments from his comfortable seat on the right side of the room. The cab is so designed that its floor supports together with front bulkhead and partition framework add considerable strength to the nose structure.

A few remarks may be added on the final sheet covering: the carefully hammered front sections of steel sheets are plug welded from the inside and all joints are finally covered with continuous butt welds. Grinding of these beads and expert polishing of the curved surfaces are the subsequent preparation for paint application. Great care and judgment are prerequisites for these operations. Figure 5 shows one of the latest cab units just before transfer to the paint shops.

(*c*) *Rear-End Framing.*—Except for the cab front, all other ends of the two or three units are identical in design. The same is true of the opposite ends of the cab units. Referring to Fig. 7 it becomes obvious, that again the antitelescoping principle was embodied into the original layouts. Thus a 13-in. wide and $^3/_8$-in. thick plate and vee together with strong end angles and inner posts provides for good impact resistance in case of accident. All materials are, of course, considered in the light of shock resistance at very low atmospheric temperatures. The welded joints of the end framing to the side framing are shown in Fig. 8.

(*d*) *and* (*e*) *Side Framing.*—The principal parts of the side framing, which is naturally of either left or right design, are best described by referring again to Fig. 4. The load-carrying high-tensile bolster posts are 6- x 6-in. H-beams, whereas intermediate posts and important

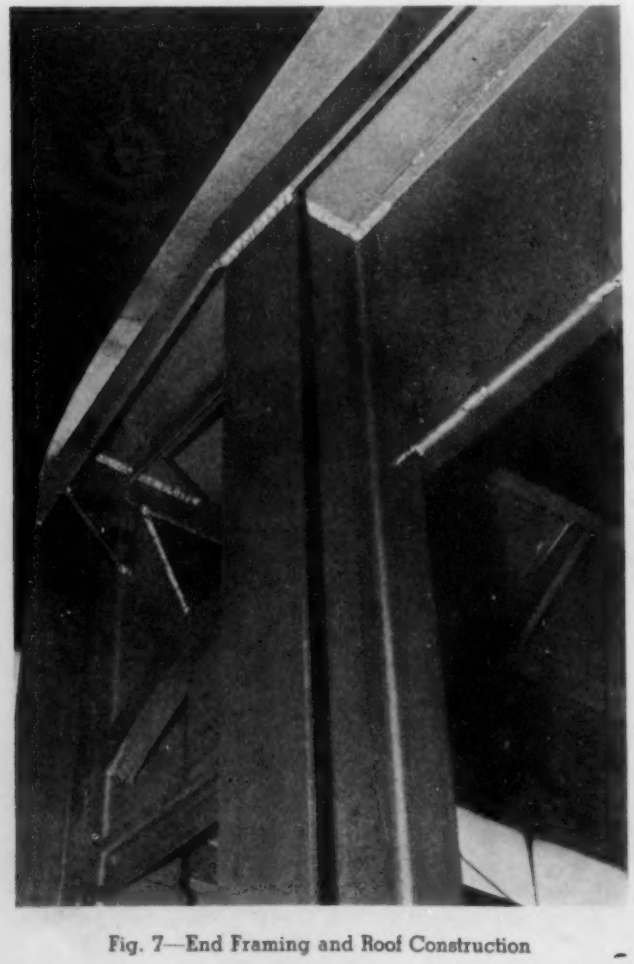


Fig. 7—End Framing and Roof Construction

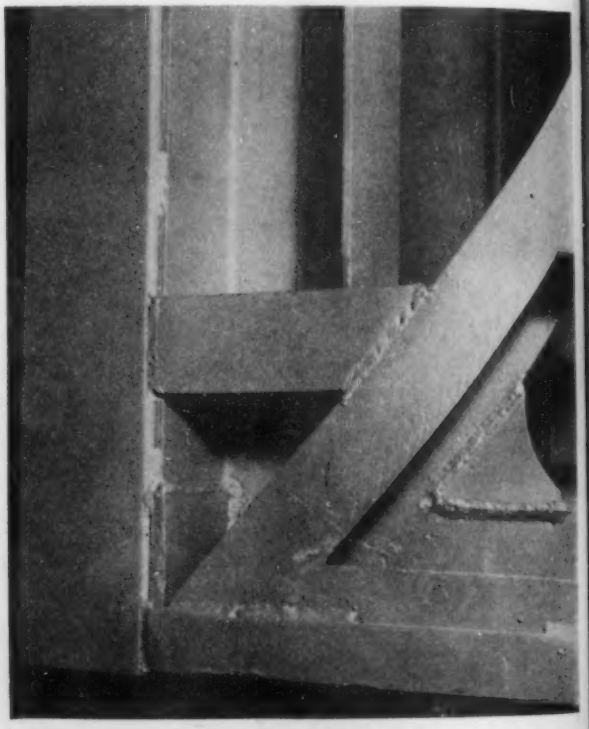


Fig. 8—Lower Corner of Rear-End Framing and Underframe

diagonals or horizontal braces are 4- x 4-in. H-beams. Various stiffeners are again added to serve as supports for the side paneling and for some mechanical equipment and piping on the finished inside of the car body. The mentioned beams are welded with high-tensile electrodes to the underframe and the outside ground flush after shot blasting the entire assembled structure. This permits the convenient application of smooth panels directly to the framework, as shall be described in paragraph (*h*).

(*f*) *Roof Framing.*—The upper part of the end and side framing is held in place by a series of lateral roof beams and roof sheets with ample provisions for the subsequent placing of the roof hatches, the openings for which indicate that the roof framing is actually a multiple stress carrier besides being a support for essential grids,

etc. The exposed portion of one of the roof sheets is shown in Fig. 12.

(*g*) *Roof Hatches.*—All large machinery or equipment, such as the Diesel engine, main and auxiliary generators, compressor, oil cooler, etc., is installed into the finished car body through the rectangular openings in the roof. After this installation, the openings are covered with suitable hatches. These are all-welded assemblies, but they are bolted to the roof, thus permitting convenient removal of some of the major equipment in case of necessary inspection or repair.

(*h*) *Outside Paneling.*—A very desirable outside finish for the flat portions of the car body has been found in the utilization of large panels of so-called metal-covered plywood. The cross-sectional characteristics of a typical 3/8-in. panel used on the sides of the locomotive are 27 gage galvanealed sheet over three-ply boards, all held together with a very strong bond of glue. In manufacture, the wood is thoroughly dried and then covered with the metallic sheet all over, the edges being hand soldered so hermetically as to keep all moisture out.

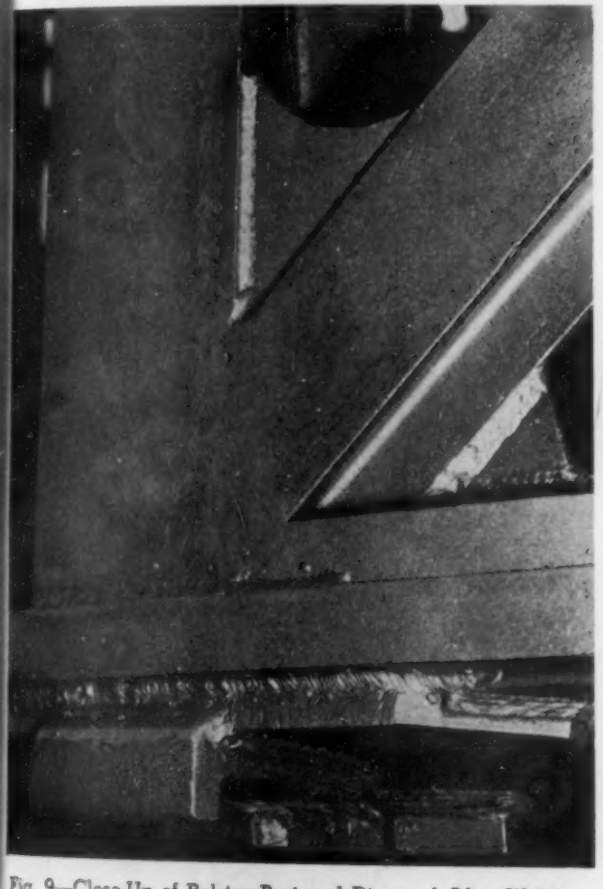


Fig. 9—Close-Up of Bolster Post and Diagonal After Welding and Shot Blasting

The carefully inspected panels are bolted to the flat outside the welded car-body structure by means of 2-in. wide, 1/4-in. thick battens, the space between two adjacent panels being filled with a special never-drying asphaltic putty. No corrections are permitted on any of the panels for reasons stated above; they just have to fit or they are rejected. This type of paneling has been found to be highly satisfactory and welding processes have permitted the advantageous use of otherwise prohibitive designs. Riveted or bolted structures could obviously never produce the smooth streamlined finish of

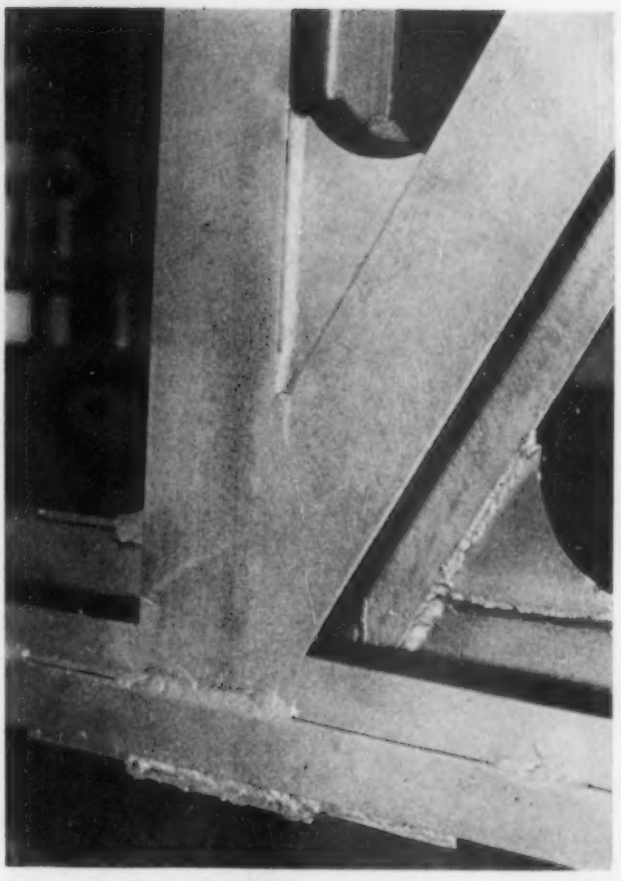


Fig. 10—Door Framing and Diagonal Welded to Underframe. Note Flush Appearance of Surface

the sides of the new multiunit locomotive. The paneled watertight car body is manually degreased and immediately protected by a coat of special priming paint.

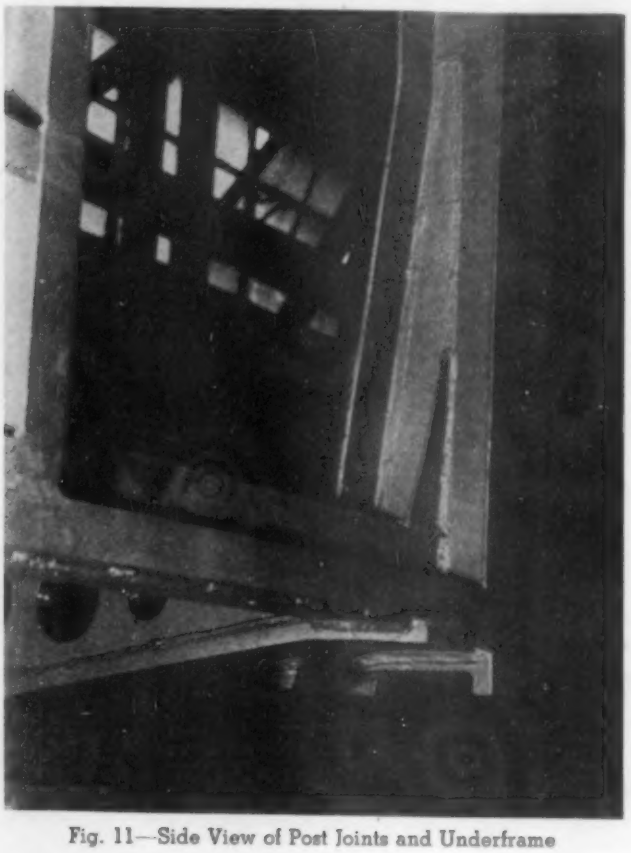


Fig. 11—Side View of Post Joints and Underframe

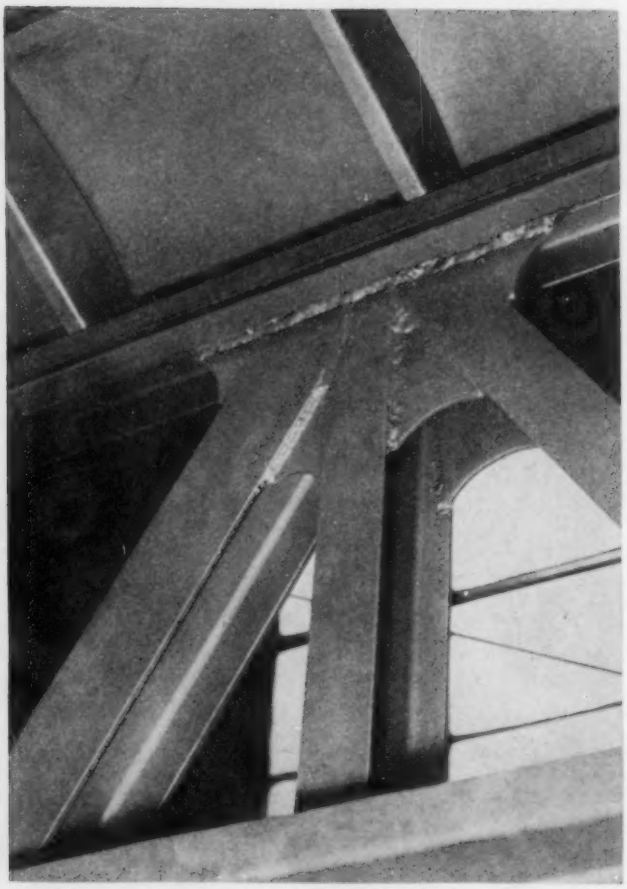


Fig. 12—Upright and Diagonal Beams Welded to Roof Framing with Sheets Tacked

The thus prepared car body is lifted from its supporting pedestals over the two trucks (see Fig. 15) and after making all electrical and flexible connections moved into the paint shops. There the final decorative effects are Duco-sprayed on the various parts of the locomotive together with the designations of railroad and locomotive number, etc.

Motive Power Plant

As indicated in the general description of the locomotive, electric current is generated by power from one 1350-hp. 16-cylinder General Motors Diesel engine of the two-cycle type in each of the four locomotive units. The engines are known as Model 567, are of the V-type, have solid unit injection and high compression with medium speed. The engine data is as follows:

Energy output	1350 hp.
Number of cylinders	16
Number of exhaust valves per cylinder	4
Diameter of crankshaft	7.5
Diameter of crankpins	6.5
Number of main bearings	10
Compression ratio	16:1
Bore, diameter	8.5 in.
Stroke	10 in.
Max. starting speed	100 r.p.m.
Idling speed	275 r.p.m.
Max. governed speed	800 r.p.m.
Total displacement	9079 cu. in.
Weight of engine, approx.	30,000 lb.
Weight per hp	22.2 lb.

The principal parts of the engine are built into a comparatively light all-welded crankcase weighing, finished-machined, about 8750 lb., which is bolted to a supporting oil pan. The cross-sectional characteristics of the engine are shown in Fig. 16. In comparison with cast crankcases of competitive Diesels weight reductions ranging from 58 to 80% have been achieved by a series of systematic developments in the design of the case until the one shown has been adopted in the latter part of 1941. The material used is predominantly one of high-tensile low-alloy plate of $^1/_2$ to $^5/_8$ in. thickness, Table 3 shows three typical metallurgical properties:

The Crankcase

As shown in Fig. 17 the crankcase is 146.25 in. long and is built of prefabricated parts such as the airboxes, bearing supports, lift hooks, etc. All joints are made by either automatic or manual welding. The automatic process is utilized in making the specific T-joint of the airboxes, which otherwise could not be accomplished by manual procedures. Its adoption was based on the studies made by the writer since early in 1936 on the

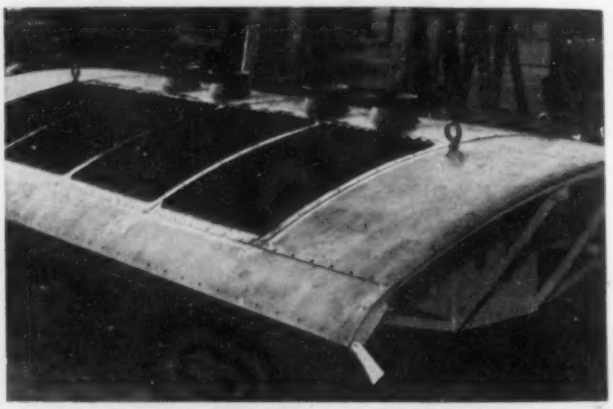


Fig. 13—The All-Welded Roof Hatch. Bolt Holes Already Marking Future Location in Roof Framing

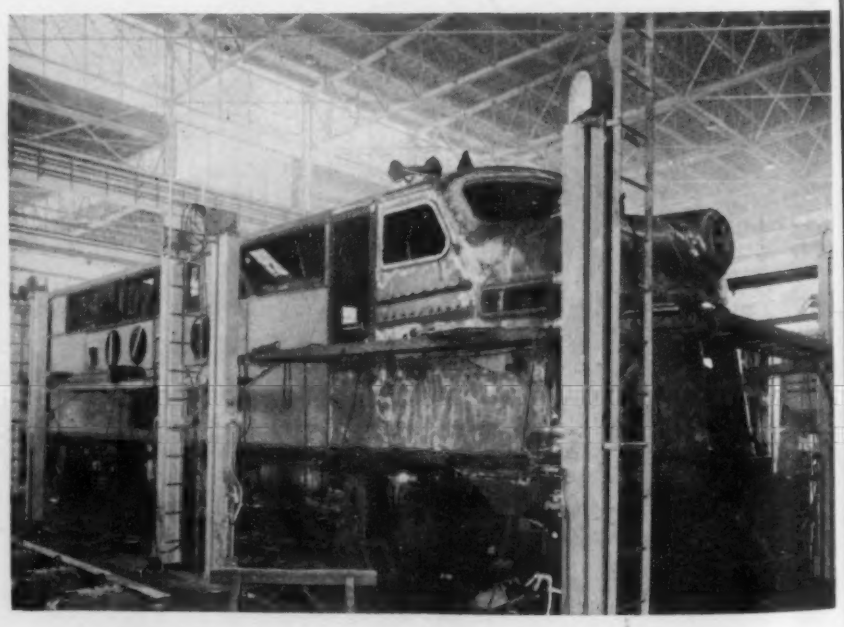


Fig. 14—Building the Cab Unit of the 5400-Hp. Freight Locomotive

high volumetric penetration of the Unionmelt process. By studying many hundreds of experimental and production welds, it has been found that for low carbon steels some 140 to 220% of parent metal is molten on the basis of 100% added welding rod metal for most butt welds and many fillet welds. This finding was developed into the T-joint, the cross-sectional macrograph of which is shown in Fig. 18. This joint is welded in the position shown and the upper $^{1}/_{2}$-in. plate of high-tensile steel is tightly clamped to the vertical $^{5}/_{8}$-in. plate of the same material. The direction of welding is from the upper side, the electrode being vertical or perpendicular to the upper plate. In order to produce the horizontal outline flush with the plate, a very carefully planned preparation is needed prior to welding. This is accomplished by machining a $^{3}/_{4}$-in. wide and $^{5}/_{16}$-in. deep groove on the upper side of the plate. The area measures 0.235 sq. in. and the total area of the complete weld 0.590 sq. in., thus indicating a volumetric penetration of 151%. The fillets shown are maintained by solid or water-cooled copper bars fitted tightly into the 90° corners. The welding procedure is as follows:

Intensity of current, amp....	1300
Voltage.....	30
Current imput, kw.....	39
Speed of welding, in. per min.....	13
Diam. of electrode, in.....	$^{5}/_{16}$

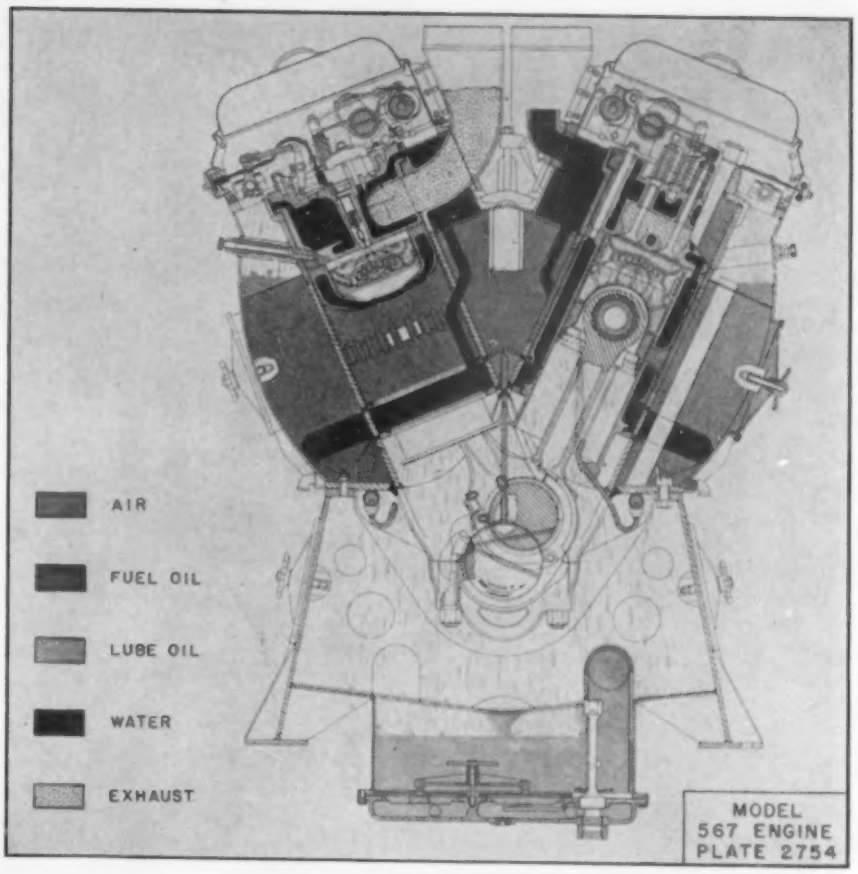


Fig. 16—Cross Section of Model 567 G-M Diesel Engine

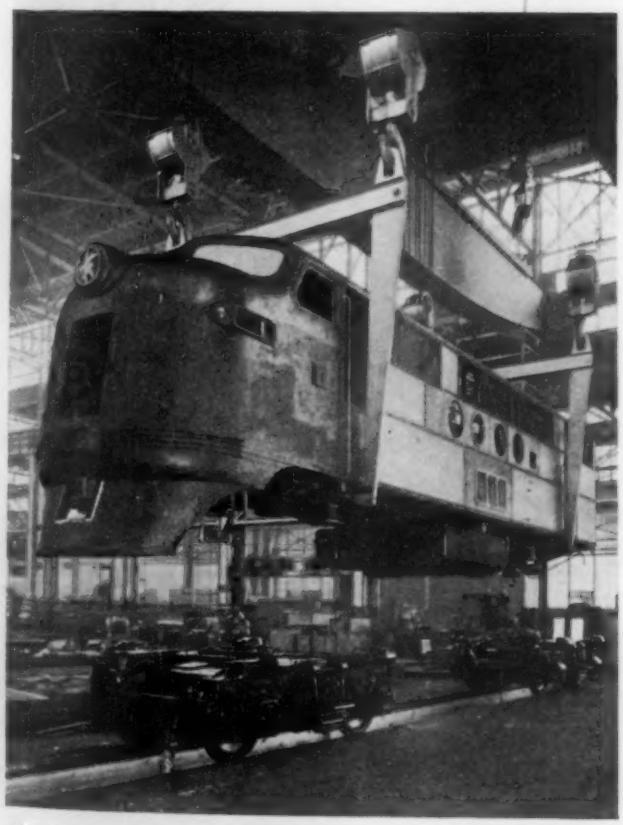


Fig. 15—"Trucking" the Cab Unit of the All-Welded Freight Locomotive

Table 3
High-Tensile Low-Alloy Plate of Welding Quality

Type of Plate	Manganese Molybdenum	Chrome Zirconium	Nickel Chrome Copper
Chemical composition, %			
Carbon	0.15	0.13	0.12
Manganese	0.85	0.68	0.88
Silicon	0.24	0.90	0.40
Phosphorus	0.018	0.023	0.015
Sulphur	0.017	0.027	0.022
Nickel	...	0.13	0.55
Chrome	...	0.50	0.68
Molybdenum	0.48	0.20	..
Zirconium	...	0.14	..
Copper	...	0.09	0.63
Physical properties			
Tensile strength, psi.	75,200	74,350	82,200
Yield point, psi.	46,140	51,300	54,800
Elongation in 2 in., %	....	37.5	31.5
Reduction of area	58.9	69.2	58.8
Rockwell hardness	B83	B83	B83
Bend test	180	180	180
Low-temperature shock Resistance (Charpy)			
Ft.-lb., at +75° F.	47	66	51
Ft.-lb., at +50° F.	47	..	..
Ft.-lb., at +25° F.	44	66	42
Ft.-lb., at 0	36	60	38
Ft.-lb., at −25° F.	20	..	35
Ft.-lb., at −50° F.	24	53	30
Ft.-lb., at −100° F.	18	39	10

Practically no corrective measures, such as chipping or grinding, are necessary since the top of the weld is flush for all practical purposes. The balance of the joints shown in Fig. 16 are made by using a nominal 0.50% mo-

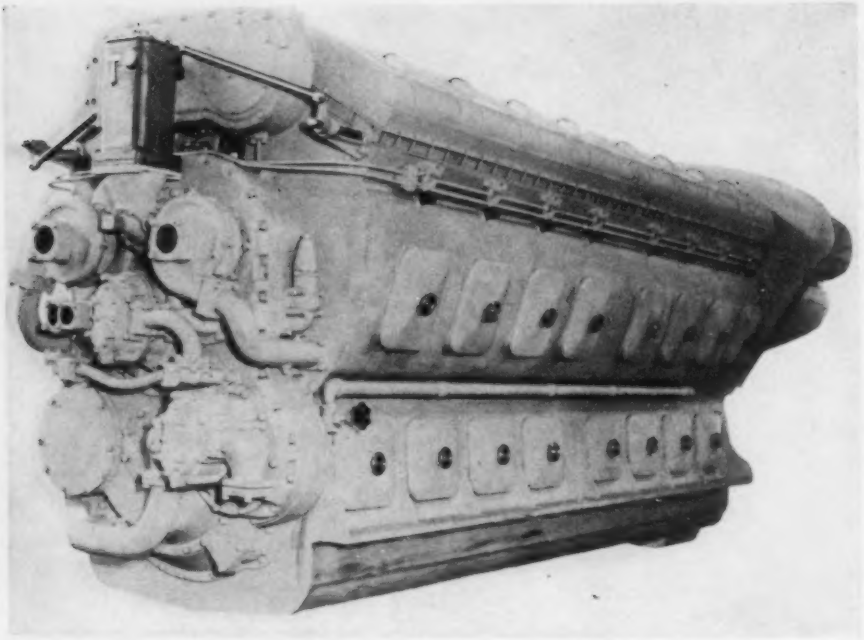


Fig. 17—16-Cylinder Diesel Engine with Welded Crankcase and Oil Pan Ready for Installation in Locomotive

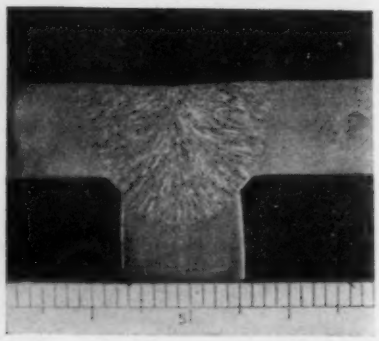


Fig. 18—Macrograph of Automatically Welded T-Joint of Engine Crankcase

lybdenum electrode. In production, positioners of two types are used in order to permit down-hand welding: one simple device moving the case along the longitudinal axis and another positioner which enables the operator to place any joint into a nearly horizontal direction by utilizing two 180° segmentary worm gears operating perpendicularly to each other. This principle follows the trends of modern welding as well as the WPB-approved conservation of hard-to-get alloy electrodes. The operators use $^{3}/_{16}$- and $^{1}/_{4}$-in. diam. electrodes at 160 to 280 amp. for most applications and good welds have been consistently obtained. After careful visional examination and dimensional checking by qualified welding inspectors, the crankcase is stress relieved in a 75- x 10- x 9-ft. gas-fired furnace. The thermal cycle consists in a 6-hr. heating to 1200 to 1225° F., soaking at temperature for 3 to 4 hr, followed by a slow cooling to 300° F. before removal. The case is shot blasted and ready for machining. The finishing involves the use of many highly specialized production machines, the description of which is outside the scope of this paper.

The Oil Pan

In the described Diesel engine, the oil pan serves primarily as a base for the engine into which pan an oil sump is built as shown in Fig. 16. This assembly supports only static loads, for which reason 0.15 to 0.23% carbon steel suffices. The engine crankcase rests on two top rails $2^{5}/_{8}$ in. wide x 1 in. thick which are welded to a $^{5}/_{16}$-in. side plate and $^{3}/_{4}$-in. end plates, respectively. The oil sump is fabricated from cold-bent $^{1}/_{4}$-in. plate which is welded into the structure as indicated. Horizontal positioners are also used by the operators and electrodes for down-hand work have been adopted for this quality welding. Little distortion has been experienced during these operations. All outside welds are ground flush to give smooth appearance. All welds of the sump must, of course, be oil tight. The length of the completed oil pan is determined by the crankcase it supports, hence, being 146.250 ± 0.005 in. The weight conforms to the expected reduction from the bulky cast bases down to about 1750 lb. finished and ready for installation into the locomotive.

Fig. 19—Two Oil Pans on Manipulator During Welding Operations

The Welded Main Generator

As indicated in the introductory paragraphs of this paper, the greatest part of energy produced by the Diesel engine is transmitted to the generator, both being integrally connected by a flexible coupling. Thus the generator produces the d-c. current for energizing the four traction motors of each unit, and its purpose is, of course, vital to the satisfactory operation of the locomotive. The design and ultimate operating features are hence equally important and a description of its main frame assembly may be an index of the returns in operating profits derived from the application of welding in the manufacture of this part of the locomotive's motive power.

The finished generator frame consists primarily of a continuous steel ring 25 in. wide, $50^1/_4$ in. I.D., which latter dimension must be accurate within ± 0.002 in. This accuracy is prompted by the interpole and field coils, which are bolted to the frame from the outside

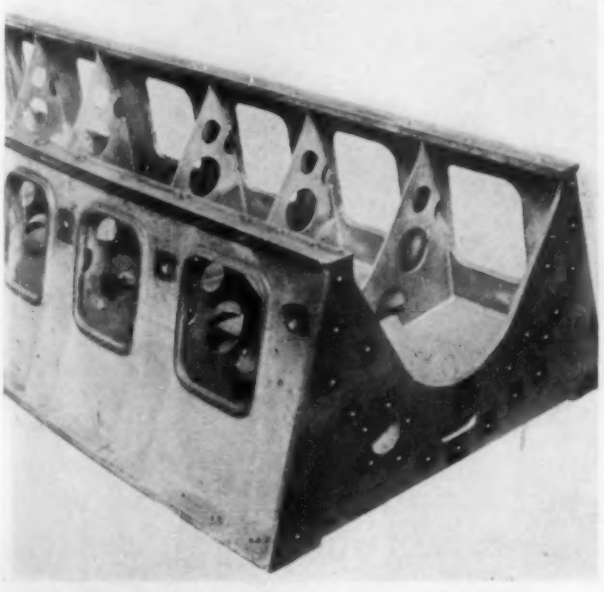


Fig. 20—End View of All-Welded Oil Pan with Sump

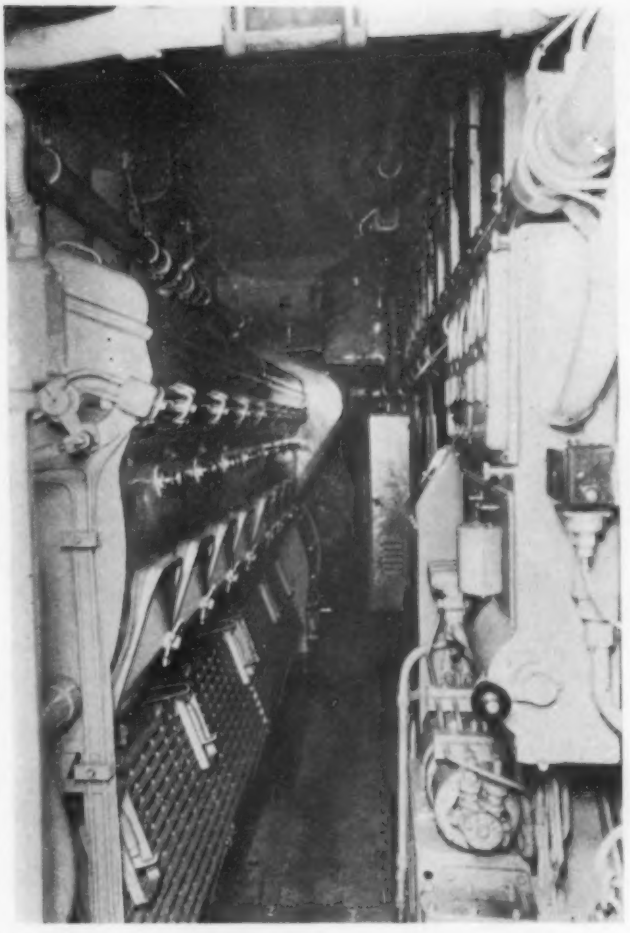


Fig. 21—Inside View of a Unit of Locomotive (Diesel Engine at Left)

	Outside Weld	Inside Weld
Number of passes	1	1
Intensity of current, amps.	2400	1200
Voltage	55	35
Speed of welding, in. per min.	6.5	4
Diameter of electrode, in.	$^1/_4$	$^7/_{16}$
Width of bevel, in.	$^7/_8$	$^3/_4$
Depth of bevel, in.	$^7/_8$	$^3/_4$

(see Fig. 22). Careful planning of operations has been worked out in order to achieve this requirement. Accordingly, the frame is fabricated from a plate 26 in. wide, about 172 in. long and $2^1/_8$ in. thick. The material must satisfy low magnetic losses as well as fairly high static strength. Both somewhat contradictory specifications are met by an intermediate analysis of which the following is a typical example:

Carbon	0.11%
Manganese	0.54%
Silicon	0.01%
Phosphorus	0.008%
Sulphur	0.018%
Copper	0.17%

This plate, weighing around 2695 lb., is cold shaped to approximate a rough ring of 54-in. O.D ± $^1/_{16}$ in. The two ends of this ring are subsequently flame beveled for automatic welding on the inside and outside of the plate. The joint is made under conditions indicated below:

After careful inspection for complete penetration, the ring is clamped to a positioner and the two legs applied by down-hand welding. These legs consist of a flat piece of steel measuring 23 x $8^1/_4$ x $1^3/_8$ in. Four equally spaced $^7/_8$ in. thick supports are then welded (as shown in Fig. 22), completing the leg assembly. The 0.13 to 0.16% carbon electrodes are of $^3/_{16}$- and $^1/_4$-in. size, currents varying from 180 to 220 amp. Four pads are welded on top of the ring into which $1^1/_4$-in. holes for lifting lugs are tapped during machining. The general view of the finished frame is offered in Fig. 22. Before any mechanical operations are performed, the rough frame is carefully stress relieved by 6-hr. heating to 1200 to 1225° F., soaking 4 hr. at temperature and slow cooling to 300° F. in the furnace. The frame is removed, shot blasted and finally machined.

Tests were made with this material in order to study the effects on flux density at various magnetizing forces, which indicated that the all-weld metal showed only very slight variations from the ring material, thus confirming that this method of construction was definitely

superior to the previously used castings, which indicated consistent magnetic non-uniformity.

Perhaps one additional possibility of modern metallurgy may be mentioned here since it offers great economies if further developed. The described method of automatic welding led the author to experiment with the use of highly sulphurized steels (up to 0.250% S)

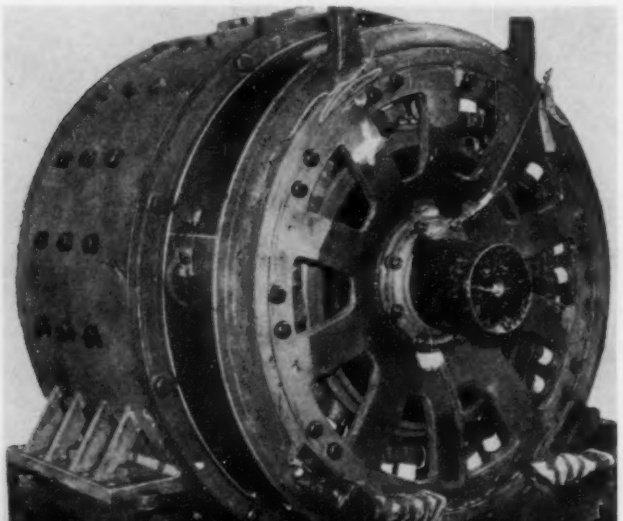


Fig. 22—D-8 Generator Showing Welded Frame on Testing Fixture

as generator frame material. This was especially tempting because preliminary tests indicated 38 to 50% less machining time for this modified analysis as compared with material of identical carbon concentration, but without sulphur. The prime consideration of magnetic reactions was investigated and the figures given in Table 4 with 0.09% and 0.15% carbon steels of both types.

Table 4

Magnetizing Force "H" in Gilberts per Cm.	Flux Density "B" in Kilogausses for 0.022% S Steel with 0.9% C	0.15% C
10	13.3	11.4
20	14.8	13.9
40	16.3	15.6
60	17.2	16.5
80	17.8	17.1
100	18.2	17.5
120	18.6	18.0
140	18.9	18.3
160	19.2	18.6
Magnetizing Force "H" in Gilberts per Cm.	Flux Density "B" in Kilogausses for 0.244% S Steel with 0.09% C	0.15% C
10	12.0	10.8
20	14.7	13.6
40	16.4	15.5
60	17.4	16.3
80	17.9	16.9
100	18.2	17.3
120	18.5	17.7
140	18.8	18.0
160	19.0	18.4

An actual macrograph of one of the welds is reproduced as Fig. 23. The conditions under which the two welds were made are:

Size of Weld	Large	Small
Width of bevel, in.	1 3/16	3/4
Height of bevel, in.	7/8	1/2
Diameter of electrode, in.	7/16	1/4
Intensity of current, amp.	2100	1200
Voltage	50	35
Speed of welding, in. per min.	8.8	10.0

Unfortunately, the experiences with automatic welding were not duplicated by manual operations. The controllable slowing up and puddling of the automatic process could not be attained consistently by available electrodes, but even so, some twenty of the generators have already been successfully tested and no differences were noted between the electrical efficiencies of both.

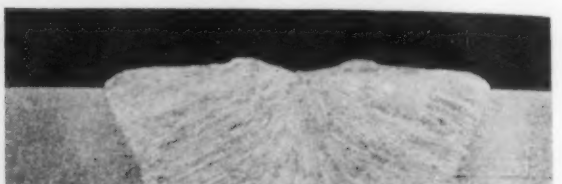


Fig. 23—Macrograph of Automatic Weld on Generator Ring Made of High Sulphur Steel

The finished generator frame is then ready for further assembly; armature, bearings, fan, main and commutating poles are installed without further application of welding. The masses involved are quite substantial, the commutator weighing around 5700 lb., the generator field 6300 lb. and the finished generator, ready for installation, some 12,950 lb.

Proportionate Operating Advantages of Welded Freight Locomotive

With the contemporary demands for increased production, the need for the highest efficiency in passenger and freight transportation becomes ever more pertinent. Anticipating this need even before the present emergency, foundations were laid to consolidate previous experiences with a wholehearted endeavor to design a power unit exclusively for welding. This tendency resulted in greatly simplified welding practices, which ultimately led to an at least 50% reduction in total time of delivery—a factor which certainly is paramount in the minds of production and defense officials. These benefits could naturally not be enjoyed without making

Table 5

Railroad	Route Covered Between	Tonnages Hauled by Steam Locomotive	Tonnages Hauled by Diesel Locomotive	Increase Over Steam, %
Boston & Maine	Mechanicville–E. Deerfield	4400	6500	48
	E. Deerfield–Boston	2350	5000	112
	Boston–E. Deerfield	2050	4000	95
	E. Deerfield–Mechanicville	2400	4200	75
Frisco Lines	Springfield–Tulsa	2550	4600	85
Monon Route	McDoel–Brainbridge	3075	5000	63
Erie	Marion–Kent	2800	5000	79
	Kent–Meadville	3100	5700	84
Southern	Oakdale–Danville	1750	3750	114

specific analyses of all items hinging on the utilization of the welding processes. The metallurgical reasons were found to be definitely sound after practically not a single weld failure was recorded even with high-speed passenger locomotives; thus it became a matter of selecting the most efficient welding machinery or generators to which appropriate welding electrodes and preferably down-hand technique must be added as decisive factors of economy. Most welding is hence done with 0.50% molybdenum and some with straight low carbon steel electrodes ranging in diameter from $^5/_{32}$ to $^1/_4$ in. Typical electrode data follows:

Diam. of electrode, in.	$^5/_{32}$	$^1/_4$
Length of electrode, in.	14	14
Normal current intensity, amp.	150	270
Voltage	27	35
Arc, kw	4.05	9.45
Coating, % in 14 in.	18.9	21.9

Frequently the current input is much greater, but actual settings depend on additional considerations, such as thickness of plate welded, degree and kind of necessary bevel, etc.

The generous use of manual and some automatic welding procedures in the building of the first freight locomotives of the Diesel-electric class should probably be evaluated in the light of a new product. This is especially true because of the claims of older operating personnel of railroads, that the newcomer has replaced steam engines at the rate of one Diesel replacing two steam locomotives. While the present facts accumulated from actual operating records are available, let us review the status of such important questions as tonnage hauled, average speed, daily mileage, fuel cost and similar items affecting the balance sheets of operations. Careful notes have been kept during the fact-finding runs over variegated terrain since 1940 and power was perhaps the first impressive advantage of the new units. Table 5 shows a few of the experiences.

The next factor of interest is average speed. Although there never has been a bona fide attempt at any speed or tonnage records, even the first 5400-hp. Diesel owned by the Santa Fe Railroad made the 1762-mile trip between Argentine, Kansas, and Los Angeles, Calif., at an average speed of 32.3 m.p.h. The locomotive pulled 68 cars or 3150 tons. The locomotive had ample reserve capacity for moving a much heavier train and at much higher speeds. Generally this run requires the services of seven steam locomotives with 12 stops for fuel and water besides 16 additional stops for water. The Diesel-electric freight locomotive stopped only four times to refill on fuel. Actual figures for several railroads are shown in Table 6.

Railroads are also interested in the maximum possible coverage of distances and greatest utilization of their expensive motive power. Table 7 gives some idea of both items.

Table 7

Railroad	Average Service, Hours per Day (Utilization)	Av. Daily Mileage	Total Mileage Covered
Northern Pacific	18.3	376	5,260
Missouri Pacific	20.0	435	4,350
Chicago, Ind. & Louisville	20.2	271	1,896
Chicago, Milwaukee	19.8	487	4,872
Atchison, Topeka & Santa Fe	17.7	402	12,871
Chicago, Burlington & Quincy	..	393	3,929
Kansas City & Southern	..	373	3,726

The foregoing tabulations are significant from an over-all viewpoint of operations. When analyzing the details of the economies it will readily be noted that they point distinctly to the use of liquid fuel, which may easily be handled and stored in welded tanks either at the terminal or en route with the locomotive. Fuel cost is therefore another index to feasible countrywide adoption of this new type of motive power in fast freight service. Fuel costs should be of interest in comparison with coal- or oil-burning steam engines (Table 8).

In fairness to coal- and oil-fired locomotives, the application of Diesel-electrics in freight service should not be viewed from annual gross savings accruing from the above tabulated advantages alone. Maintenance costs, fair depreciation, expected availability and some addi-

Table 6

Railroad	Route Between	Distance in Miles	Tonnage Hauled Steam Locomotive	Tonnage Hauled Diesel Locomotive	Average Speed, M.p.h.	Increase in Speed Over Steam %
Northern Pacific	Pascoe–Spokane	98	..	6,000	26	160
Missouri Pacific	Kansas City–St. Louis	283	4800	5,675	36	72
Kansas City Southern	Pittsburg–Dequeen	210	2650	3,250	21	17
Milwaukee	Othello–Avery	212	4200	6,010	26	86
Great Northern	Wenatchee–Minneapolis	1612	..	5,400	31	Never attempted
Baltimore & Ohio	Kelly Lake–Allouez	105	..	16,200	26	44

Table 8

Railroad	Mileage Covered	Cost Items	Steam Engine Coal-Burning	Steam Engine Oil-Burning	Diesel-Electric
Rio Grande	127	Cost of fuel	$2.36/ton	.....	$0.045/gal.
		Consumption of fuel	336 lb.	.....	2.84 gal.
		Cost per M.G.T.M.	$0.397	.....	$0.124
Kansas City Southern	430	Cost of fuel	$2.40/ton	$0.022/gal.	$0.045/gal.
		Consumption of fuel	150 lb.	7.5	2.15 gal.
		Cost per M.G.T.M.	$0.1798	0.1642	$0.0978
Santa Fe	81	Cost of fuel	.....	$0.020	$0.0425/gal.
		Consumption of fuel	.....	14.6	3.6 gal.
		Cost per M.G.T.M.	.....	0.292	$0.153
Missouri Pacific	283	Cost of fuel	$1.86	.....	$0.0375/gal.
		Consump'ion of fuel	58 lb.	.....	1.03 gal.
		Cost per M.G.T.M.	$0.0539	.....	$0.0384

tional items cannot be ascertained from the experiences acquired so far. There is no reason to believe that these entries on the balance sheets should not be maintained in the future years. Nevertheless, in scrutinizing the proportionate savings derived from the complete units, arc welding must be credited with the fact, that it was this process together with the adoption of more modern generation and transmission of motive power, which resulted in these successes. The new locomotive is decidedly safer and easier to operate, is faster, does outperform any other steam locomotive and is nearly 100% available. These claims have been repeatedly substantiated by performance data in spite of most adverse traffic conditions. The true social advantages of the all-welded Diesel-electrics will, without doubt, inaugurate a new era of their truly universal acceptance—when materials shall again be available to private enterprise after serving our country to move more troops and their equipment at faster and more reliable schedules and at lowest operating costs.

Plate-Carrying Clamps*

By Louis Hardnack†

THE above drawing illustrates one of a pair of plate-carrying clamps which were fabricated by and for use at The Johnston and Jennings Co., Cleveland, Ohio. These clamps were needed for unloading plates of varying thicknesses and carrying plates to the cutting department. Plates being handled by these hooks vary from $1/2$ to 3 in. in thickness and are generally 60 in. wide by 240 in. in length.

A test was made recently in which these clamps were placed approximately two feet from one end of a 3-in. plate, 60 x 240 in. The plate was then picked up by a crane until the entire plate was free of the floor. The clamps did not allow the plate to slip out sideways, in spite of the large unbalanced load.

The maximum load which has been lifted to date by these clamps has been five $3/4$-in. plates, 60 x 240 in. long, approximately 15,300 lb., or better than $7\frac{1}{2}$ tons.

The above idea fills a need for a set of clamps which are easy to make, simple to use and a fixture that will perform with absolute safety. The recap of cost that follows is based on regular labor rates and includes manufacturing overhead.

Factories large and small are not overlooking the possibilities of arc welding in building factory equipment, particularly now with deliveries of machines and critical materials such a problem. Such equipment can often be fabricated at minimum cost from the scrap material that formerly would have been sold for junk.

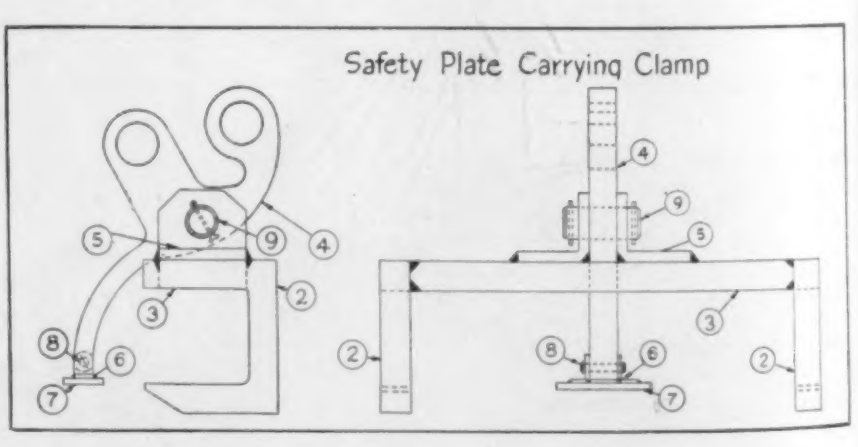
1.	Clamps	Welded construction
2.	End plates	$1\frac{1}{2}$ x $7\frac{1}{2}$ x $6\frac{1}{2}$ in.
3.	Plates	$1\frac{1}{2}$ x $4\frac{1}{4}$ x 19 in.
4.	Plates (swivel)	$1\frac{1}{2}$ x 9 x 17 in.
5.	Angles ($4\frac{1}{4}$ in. long)	$3\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{2}$ in.
6.	Angles (1 in. long)	$1\frac{1}{2}$ x 1 x $\frac{1}{4}$ in.
7.	Plates	2 x 5 x $\frac{1}{2}$ in.
8.	Pins	$\frac{3}{4}$ in. diam. x $2\frac{1}{2}$ in. long
9.	Pins	$1\frac{1}{2}$ in. diam. x $3\frac{3}{4}$ in. long
10.	Cotter pins	$\frac{3}{16}$ x 2 in. long
11.	Cotter pins	$\frac{3}{32}$ x 1 in. long

Material

Angles, steel, pins, rod	$13.01

Labor

Layout, fit, cut and weld	19.24
Total material and labor	$32.25



* Winner of an award in Hobart's Arc Welding Monthly News Contest.
† Cleveland, Ohio.

Mechanical Load Handling Equipment*

By E. W. Weaver†

A CONSIDERABLE factor in freight car savings has been the use of mechanical load-handling equipment. The purpose of this paper is to discuss the main design problem in the development of a machine for this purpose and its clean-cut solution, made possible by the electric arc-welding process. This machine, shown in Fig. 1, was brought out late in 1940 to meet the need for a smaller and more flexible unit. By its use the loading and unloading of a car becomes the matter of minutes instead of hours. It has the ability to pick up and transport loads with speed and dispatch, threading its way along narrow aisleways. It will raise and deposit its load at any desired height up to 11 ft. In fact, it is a speedy, traveling elevator. Figures 2 and 3 are photographs of the machine in action. That compactness is a prime essential in the design of a machine for this work is shown by Fig. 4, a diagram of its operation within the car.

Machines of this general type are not new. In fact, the railroads pioneered in seeking an answer to quicker loading and unloading of cars. Quite an industry was built up to help them in the solution of this problem. The early trucks were all electric storage battery powered. This source of power in itself imposed definite limitations. The low platform lift did not permit of tiering loads and the construction was crude and bulky.

In 1933, the company with which I am now connected entered the lift truck field with the machine shown in Fig. 5. This was a fundamentally new combination of elements, each of which had been proved in other applications. These were:

(*a*) Gasoline engine power.
(*b*) Driving wheels at the front end, steering at the rear.
(*c*) Hydraulic means for lift and control of load.
(*d*) Central seating for the driver, giving him full vision, comfort and safety.
(*e*) An electric-welded frame structure.

That this is now practically standard construction for industrial trucks of this type speaks well for the vision of the head of the company and designer of the truck. This machine, as originally designed, was for 4000-lb.

Fig. 2

Fig. 3

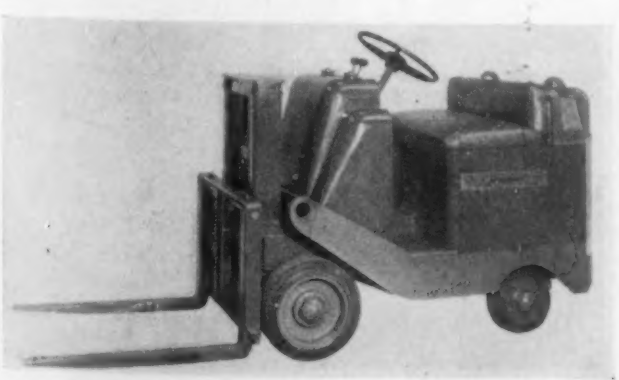


Fig. 1

* Second Prize Award Paper in the Classificational Awards A, Automotive Division of the 1940–42 Industrial Progress Award Program sponsored by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.
† Consulting and Design Engineer, Towmotor Co., Cleveland, Ohio.

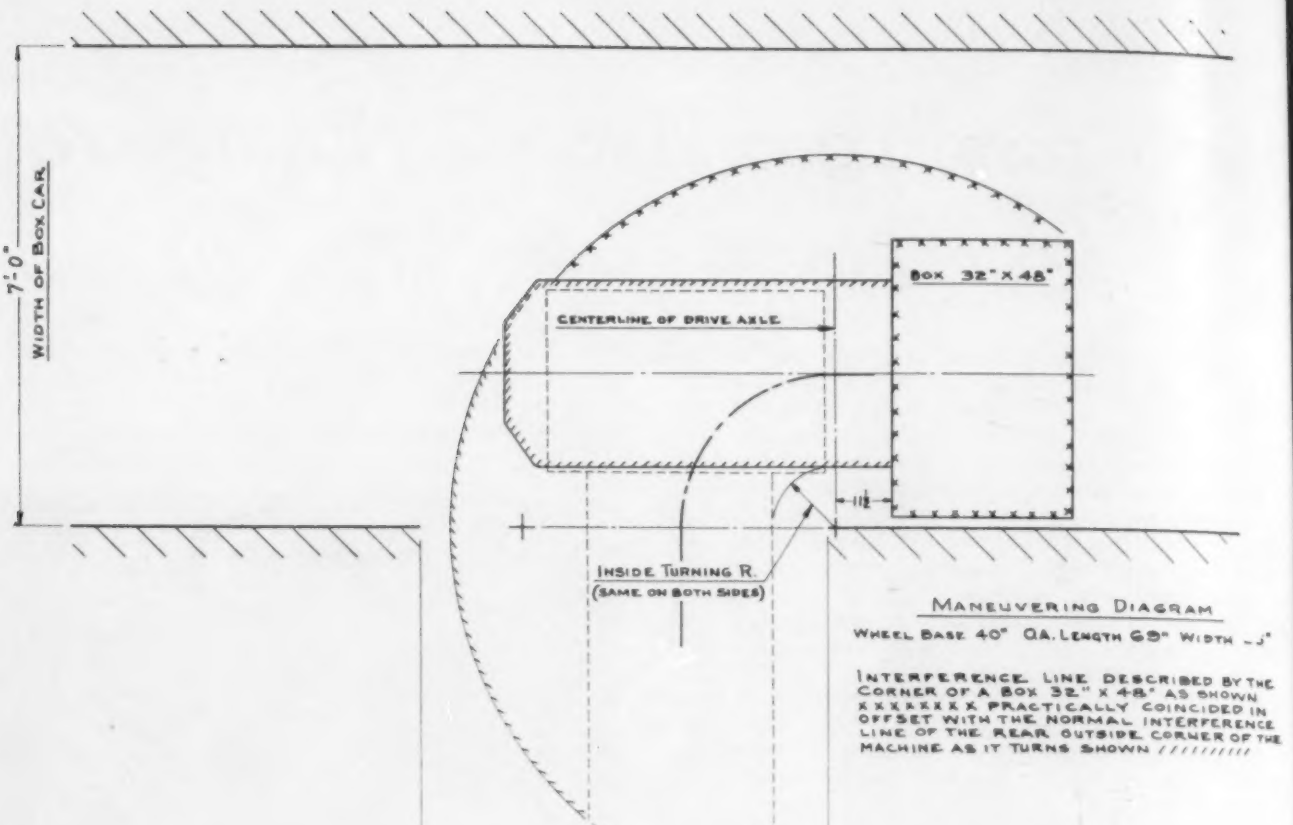

7'-0"
WIDTH OF BOX CAR
BOX 32" X 48"
CENTERLINE OF DRIVE AXLE
INSIDE TURNING R.
(SAME ON BOTH SIDES)
MANEUVERING DIAGRAM
WHEEL BASE 40" OA. LENGTH 69" WIDTH -J"
INTERFERENCE LINE DESCRIBED BY THE CORNER OF A BOX 32" X 48" AS SHOWN XXXXXXXX PRACTICALLY COINCIDED IN OFFSET WITH THE NORMAL INTERFERENCE LINE OF THE REAR OUTSIDE CORNER OF THE MACHINE AS IT TURNS SHOWN
6'-0" DOOR

Fig. 4

load capacity at 24-in. load center. It was 40 in. wide, with 56-in. wheel base, and had an over-all length, less load, of 93 in. Its over-all height was 84 in., and it could lift its load 52 in. It had an outside turning radius of 96 in.

The marked savings effected in material handling where this machine was put into use brought a constantly increasing business to the company all through the depression years. Electric arc welding made possible the practice of "tailor making" each machine to fit the needs of the customer. Masts were made of special

Fig. 5

Fig. 6

heights to give any desired lift. Wheel base and other factors were modified so that constantly increasing capacity was obtained. Today the machine is being built with wheel base up to 72 in. and capacity rating up to 10,000 lb. at 25-in. load center (see Fig. 6 for present example of this model).

Early in 1940, the writer was given the task of the design of smaller capacity machine. In addition to the five fundamentals ((*a*) to (*e*) outlined above) tentative general specifications were laid down as follows:

(*f*) Maximum capacity—3000 lb. at 15-in. load center.

(*g*) Most compact design possible and with minimum turning radius.

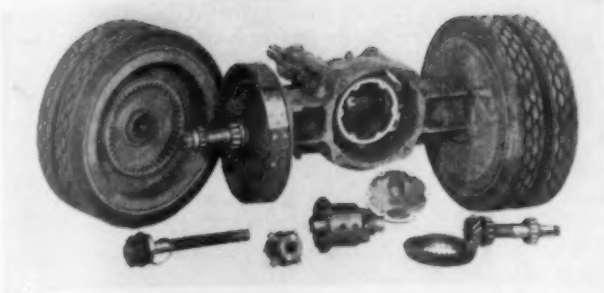


Fig. 7

(*h*) Full accessibility to every service part.
(*i*) Standardized construction to permit of mass production technique.

The final specifications worked out to be: width, 35 in.; wheel base, 40 in.; over-all length without load, 70 in.; outside turning radius, 68 in. Provision was made for mast heights to give lifts of 7, 9 and 11 ft. The most popular height proved to be the one that will nicely pass through a 7-ft. door and will lift to a height of 9 ft.

Not much need be said in regard to the general design of the truck, except that throughout the design electric arc welding has consistently been used—mast, carriage, tanks, cowl, etc., all being of welded construction. The unusual frame, made possible only by the arc-welding process, is the particular reason for this paper.

Construction of the older model at the drive axle is shown by the separate photographs, Figs. 7 and 8. The wide flanges close to the wheels will be noted on Fig. 7 of the axle, and the mating flanges on the frame are clearly shown on the left-hand side of Fig. 8. The tubular bar just above at this point on the frame is for the mast hinge.

In the design of the smaller model, it was desired to lower the driver's seat, thus giving easier access to the driver's position. This necessitated lowering the engine so that the crankshaft center line was on a level with the top of the frame and the flywheel and its housing must lie between the two side members.

The important functions of the frame are as follows. First, it must carry the mast with its load. Second, it serves as the platform on which all the machinery, power plant, etc., is mounted. It also provides space for the operator. Third, attached to the frame on the under

Fig. 8

side are the springs, axles, wheels and other supporting elements. Fourth, the frame should conform to the general design of the machine as a whole in a manner to easily promote an attractive exterior.

With the machine width established at 35 in. to permit traveling through a 3-ft. passageway, the problem is one

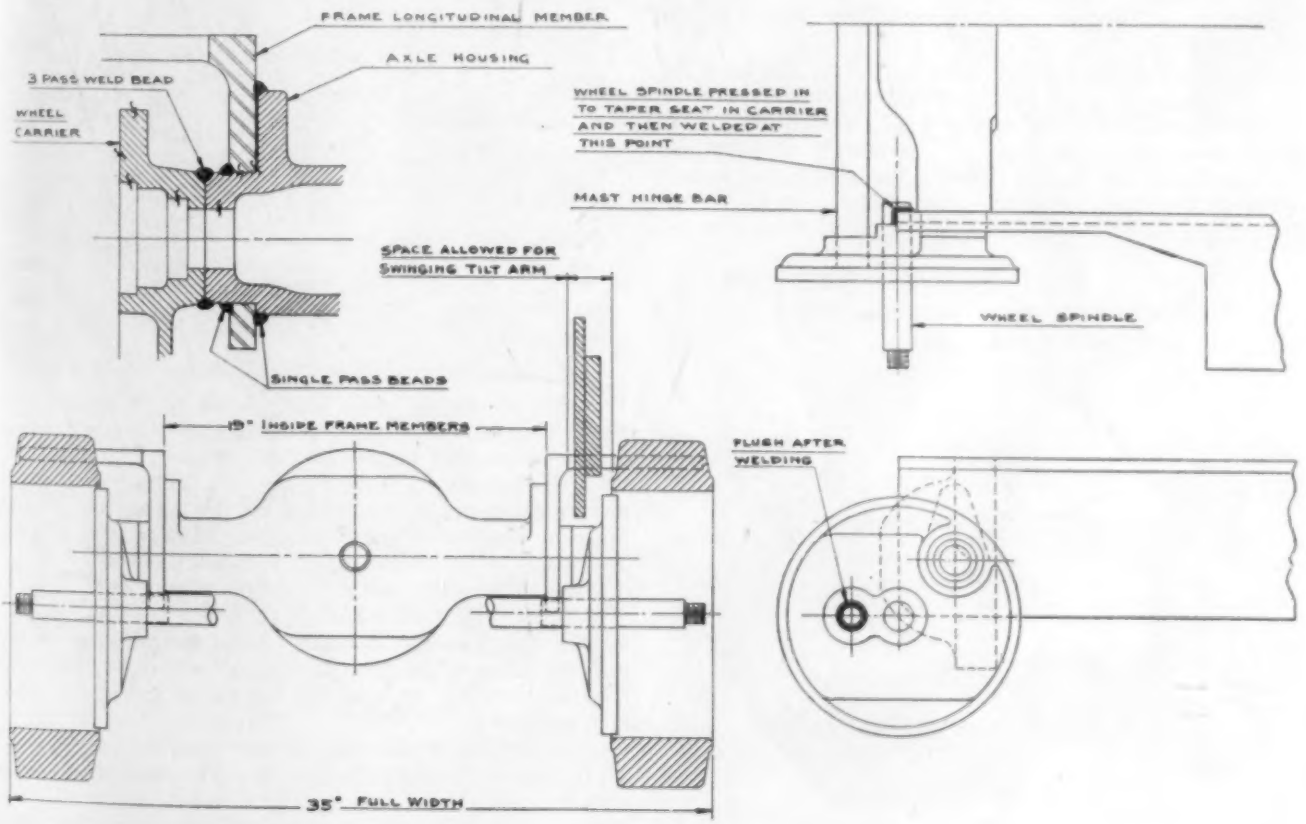

FRAME LONGITUDINAL MEMBER
AXLE HOUSING
3 PASS WELD BEAD
WHEEL CARRIER
WHEEL SPINDLE PRESSED IN TO TAPER SEAT IN CARRIER AND THEN WELDED AT THIS POINT
MAST HINGE BAR
SPACE ALLOWED FOR SWINGING TILT ARM
WHEEL SPINDLE
SINGLE PASS BEADS
19" INSIDE FRAME MEMBERS
FLUSH AFTER WELDING
35" FULL WIDTH

Fig. 9

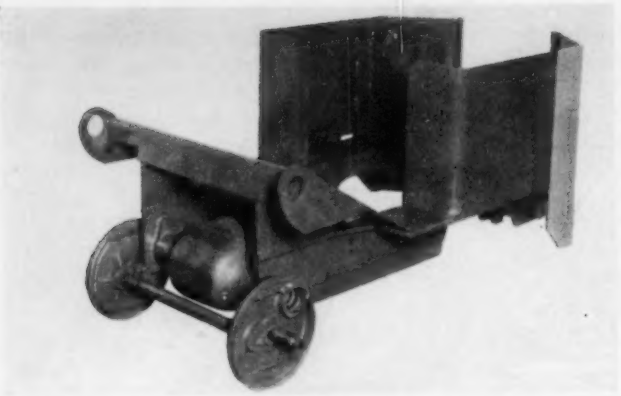


Fig. 10

of apportioning the available space so as to provide for the functional demands. It is, of course, axiomatic that the design must be not only functionally sound but practical to produce. For production reasons the frame side members should be kept parallel. The distance they must be separated is such as to contain the flywheel housing and related accessories. Nineteen inches was the width determined. The next factor to receive consideration was tires. For the expected load, a need for 10-in. is quickly and definitely settled by reference to manufacturers' capacity rating table.

The mounting of the mast provides for its backward and forward tilt in order to properly handle the load. This tilting movement is by means of hydraulic-operated cylinders attached to the frame. These actuate the mast through side arms located between the frame and the wheel. Structural requirements for these arms and clearance space require $1^3/_4$ in. on each side or a total of $3^1/_2$ in. There now remains from the original 35 in. only $2^1/_2$ in. in which to provide for two rugged side members, and proper attachment of the frame to the axle structure.

The problem was further complicated by the keen desire for short over-all length of the machine. For efficient counterbalancing of the load, it is necessary to locate the carriage as close to the wheels as practical. The mast must be located between the wheels and hinged either on the frame or on the axle. There are, therefore, three elements clamoring for space at the same point:

1. The axle for cross beam and gear housing space.
2. The frame for a rugged cross member.
3. The mast for a suitable hinge.

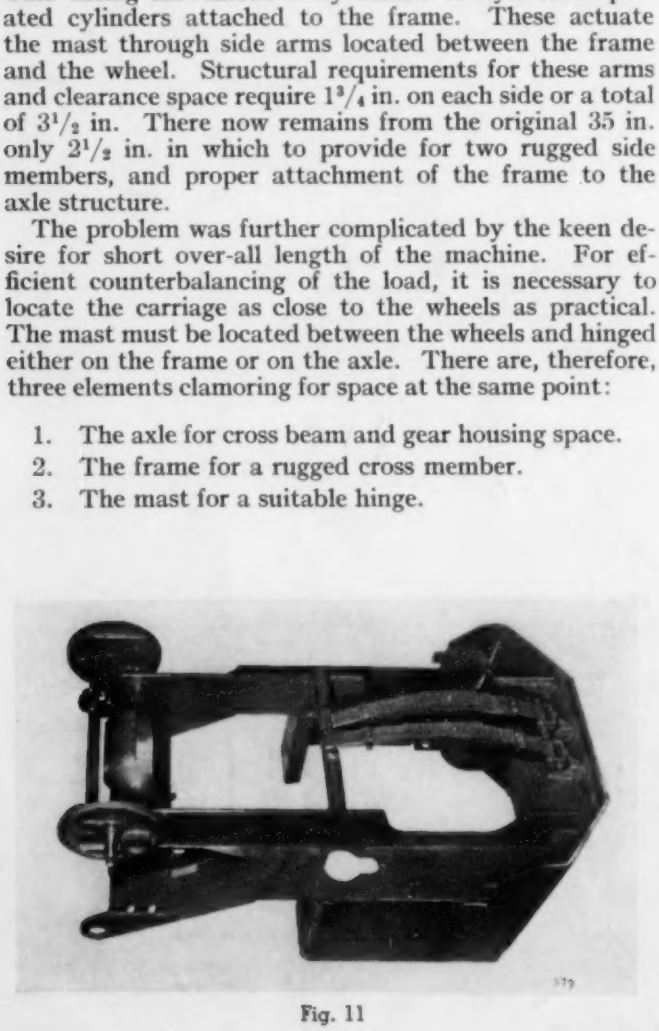


Fig. 11

The design, as it eventually worked out is shown in Fig. 9. Figure 10 is a photograph of the frame, showing its front and side at this point. Figure 11 is a photograph showing the construction from the under side. Figure 12 depicts in perspective the factors for which provision must be made and the progressive buildup toward the sturdy, rugged unit that the frame becomes as the detail parts are electrically arc welded together.

Referring to Fig. 12, at the upper left-hand corner is shown the gear train, the shafts of which must be journaled with precise and permanent accuracy. Below is shown the typical automotive bevel gear differential carrier, adjacent to which is shown a housing setup that might (but does not) serve as a separate axle structure. At the right is shown in related position the frame elements. Basically, the frame consists of four pieces. The two longitudinal members—A-1 and A-2—are made from common 8 x 8 x $^5/_8$ structural angle. Note how the flange sections are cut to form clearance space for the wheels. The keyhole shape in the top flange is for the hydraulic tilt cylinder. The holes at the extreme left are bored to fit the turned pilots on the end of the axle housing *B*. As the distance between the shoulders on this cast steel housing and the length of the rear cross member, *C*, are both 19 in., the setup of the frame for welding is extremely simple. Inserting the housing pilots in the bored holes, making sure that the finished face of the housing is in proper angular relationship with the top line of the frame, locating the 3-in. thick rectangular block *C* at the rear in its proper position, clamping the parts together, the job is ready for welding.

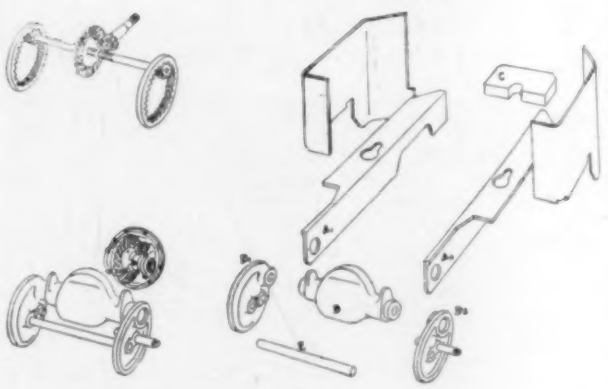


Fig. 12

Figure 9 shows the weld beads both inside and outside the angle web, as the parts are joined at this point.

The alignment of the wheel carriers (D-1 and D-2) with the housing *B* is by means of a combination alignment and clamping bar, which fits the accurately reamed holes in the above parts. Before welding, the carriers are properly positioned relative to each other by inserting the mast hinge bar, *E*. All three are now brought into proper relative position to the top of the frame, tightly clamped and welded. This second stage of the welding process must be performed with care, as on its relative accuracy depend the quietness and life of bearings and gears.

Considerable credit must be given to the engineers of The Lincoln Electric Company for encouraging us to proceed along these lines and then in helping us to make it a success. The balance of the welding job on the frame is quite conventional and requires no comment.

While we feel that the factor of production costs is of minor significance as compared with performance characteristics of the machine, cost records show an appreciable saving. (The table given below deals only with those factors directly involved and does not show total costs.)

It is, therefore, apparent that on the 329 machines produced in the 18 months since the introduction of this model, there has been a saving of $17,124.45 to the manufacturer. With increased production to meet growing demand this saving will be augmented.

A more important factor is the saving to the users of the machines.

	Old Design	New Design
Axle structure	$57.20	$46.12
Bevel gear housing unit	59.25	40.60
Frame structure	22.58	3.13
*Welding on frame at 14.3 cents per ft.	2.46	1.19
Assembly details—bolts, etc.	1.60	0.00
	$143.09	$91.04

Or a saving of 36.4%

* The average cost of depositing a single pass 1/4- or 5/16-in. fillet weld bead is 14.3 cents per foot on this sort of work, in our plant at this time.

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(*Continued from page 604*)

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Precautions for Preventing Personal Injury to Welding and Cutting Operators

By H. F. Reinhard*

STATISTICS show that during the war there has been a marked increase in man-hours lost because of personal injury to workmen. This is not surprising when it is considered that, in the pressing need for ever-increasing wartime production, industry has enlisted for manual labor thousands upon thousands of men from stores, offices and the professions who never before have had any experience at this type of work. Careful study of the causes of this increase reveals that a large percentage of the injuries did not "just happen" but were the result of carelessness or negligence and were therefore preventable.

Oxyacetylene welding and cutting are not hazardous occupations, but a welding or cutting operator, like any other mechanic, may become injured if he permits himself to grow careless. The following suggestions are presented as an aid to all operators in assuring their own personal safety.

Roll Down the Sleeves to Protect the Arms from the Heat

Wearing Apparel

One of the most frequent forms of carelessness is improper wearing apparel. Most operators take a great pride in their welding and cutting equipment and are careful to keep it in top-notch working order, yet many of these same operators will without a thought needlessly expose themselves to the danger of severe flesh burns by failure to provide themselves with proper work clothes or to adjust them properly. Work clothes should be free of oil or grease and also of frayed edges and torn patches where sparks can lodge and start burning.

Woolen clothing is preferable to cotton because it does not ignite so readily. Likewise, a fabric with a hard, smooth finish is preferable to one with a nap. Woolens also protect the skin from the almost unavoidable sudden changes in temperature that an operator must experience.

* The Linde Air Products Co.

Trouser Cuffs

Before starting a welding or cutting job the operator should always roll down the sleeves of his shirt and the cuffs of his trousers. The latter is particularly important when cutting is to be done. If this precaution is not taken, flying sparks or hot slag are quite likely to

Turn Down the Trouser Cuffs so That Hot Slag and Sparks Will Not Lodge in Them

lodge in them, and before the operator is aware of it, his clothing will be on fire and a painful burn may result. For the same reason, the flap on the breast pocket of the shirt should be buttoned or, better yet, the pocket should be removed entirely.

Shoes

Hot metal or slag may also lodge inside of low shoes. Adjust the suspenders or belt, therefore, so that the trouser legs almost touch the ground at the heels. This will help keep the slag out. High shoes are much to be preferred to oxfords if they are available. Those of the congress gaiter style are the most practical, since they have no lacers or tongues to catch the sparks. Iron molders nearly always wear congress gaiters, as they have learned from experience that these offer the best foot protection.

Gloves

Every operator should provide himself with a good pair of asbestos, leather or fireproof fabric glove of the long, gauntlet type. The gauntlets not only ward off the sparks but also protect the hands and lower forearms from the heat.

Goggles

At all times while welding or cutting, or observing such work, the eyes should be protected by a pair of good, well-fitting goggles designed especially for use with the oxyacetylene process. Goggles serve the two important purposes of eliminating glare and as a protection against flying sparks.

The light from the inner cone of the oxyacetylene flame is in itself quite intense, but the molten metal in the section that is being welded or cut produces a far greater glare. Eyestrain is sure to result if welding or cutting is done for any length of time without goggles. In welding, the eyes may be very close to the work for hours at a time so that the strain is much greater than in most other operations where molten metal is involved.

Aside from the question of glare, the eyes are so close to the work that it is most advisable to protect them

against flying sparks or particles of molten metal that may be spattered about. Goggles also protect the eyes from reflected heat, which dries the surface of the eyes, causing irritation.

Correct goggle lenses are made of special-colored optical glass that minimizes the effect of glare and at the same time permits the operator to see his work clearly. Goggle lenses are available in light, medium and dark shades. In general, the light shade is for cutting operations, the medium shade for average run-of-shop welding operations and the dark shade for heavy welding where a large puddle of molten metal is present, such as in the fusion welding of a large grey iron casting.

Goggle frames should, of course, be lightweight and well-ventilated, and should fit the contour of the face for the sake of comfort. Fiber, hard rubber and plastic are ideal goggle-frame materials since they do not break easily when dropped and do not absorb heat. Frames made of metal soon become hot and burn the operator's face.

Added Safeguards

A piece of sheet metal leaned against the worktable will to a large extent reduce the possibility of burns to the feet and ankles.

A pail of water placed directly beneath a cut to catch the oxides and sparks is another efficient method of preventing burns. It will also prevent the sparks from scattering about the floor, where they may lodge in an obscure crevice and smolder for hours, then cause a fire long after the cutting job has been finished.

As an added protection to knees, thighs, and waist, many operators wear a light leather apron.

Long, Gauntlet Gloves of Asbestos or Fire-Proofed Leather Protect the Operator's Wrists and Forearms

Don't "Dust" Clothing with Oxygen

Workmen sometimes use compressed air to blow dust and dirt from their clothing. It is bad practice, but the use of oxygen for this purpose is infinitely worse. A spark or hot particle that has lodged in the fold of the clothing may be smoldering unnoticed. A stream of pure oxygen, by causing the fabric to burst into flame, can easily cause a severe flesh burn, not to mention a ruined garment and a needless waste of oxygen. If you yourself are not guilty of this bad habit but see one of your companions thoughtlessly dusting his clothing with oxygen, you will render him a real service by calling his attention to the hazard.

Use Tongs for Hot Metal

When welding relatively small pieces of metal, keep a pair of blacksmith's tongs handy for turning over or otherwise handling the pieces. Although metals quickly cool sufficiently to lose their red color, they will for a long time retain enough heat to burn the fingers severely if picked up without gloves. Even if gloves are used, hot metal will soon scorch and ruin them. Cultivate the habit of never picking up a piece of metal in the welding shop without first testing it to see if it is hot by touching it quickly. This habit will prevent many a burned finger.

Goggles Prevent Eyestrain from the Glare of the Molten Metal and Are Also a Protection Against Flying Sparks

Watch Falling Scrap

Cutting operators may laugh at the story about the absent-minded chap who climbed out on a limb and sawed himself off, but they are themselves often guilty of an equally foolish performance—they cut off a piece of steel with a blowpipe and permit the scrap piece to fall on their foot. It is surprising how often this occurs. Before starting a cut, the careful operator will anticipate what will happen when the piece is severed and will govern himself accordingly by making provision to eliminate the possibility of injury either to himself or to others.

While adjusting the work, the regulators, or the clothing, the operator should not lay the blowpipe down on the welding table with the flame lighted—not even for a moment. He or his helper may brush against the flame or the weight of the hose may cause the blowpipe to shift. In either event a severe burn may be sustained. Furthermore, letting the blowpipe burn while it is not in actual use is an unpardonable waste of oxygen and acetylene.

It is hoped that this discussion of a few common-sense precautions will not lead some of the newer welding and cutting operators to believe that the oxyacetylene blowpipe is a dangerous, hazard-breeding instrument, because it is not. Properly handled, it is as harmless as any other piece of shop equipment and has long been recognized as one of the most useful tools of industry. The welding and cutting operator, however, like the operator of a lathe, a punch press, a lawn mower or an automobile, should observe all ordinary safety precautions.

THE AMERICAN WELDING SOCIETY

ACTIVITIES — RELATED EVENTS

1943–44 OFFICERS AMERICAN WELDING SOCIETY

Since no nominations other than proposed by the Nominating Committee have been made by 25 qualified members, as prescribed by the By-Laws, the nomination ballots are treated as election ballots. Accordingly, the following have been elected officers for the year to begin on the adjournment of the 1943 Annual Meeting. These officers will be declared elected at the Business Session of the Annual Meeting.

President, David Arnott, Vice-President, American Bureau of Shipping, New York, N. Y.

First Vice-President, Isaac Harter, Vice-President, Babcock & Wilcox Company, Barberton, Ohio.

Second Vice-President, A. C. Weigel, Vice-President, Combustion Engineering Co., Inc., New York, N. Y.

Directors at Large: H. W. Pierce, Welding Engineer, New York Shipbuilding Corp., Camden, N. J.; E. R. Seabloom, Supervising Engineer, Crane Company, Chicago, Ill.; K. V. King, Engineer, Standard Oil Company of California, San Francisco, Calif.; J. H. Deppeler, Chief Engineer & Works Manager, Metal & Thermit Corp., New York, N. Y.

District Vice-Presidents: New York & New England—F. C. Fyke, Material Engineer, Standard Oil Development Co., Elizabeth, N. J. Middle Eastern—C. H. Jennings, Research Engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Middle Western—G. N. Sieger, President & General Manager, S.M.S. Corp., Detroit, Mich. Southern—E. C. Chapman, Metallurgical Engineer, Combustion Engineering Company, Chattanooga, Tenn. Pacific Coast—J. C. Gowing, Southern California Representative, Hobart Brothers, Los Angeles, Calif.

ADAMS LECTURESHIP

The Board of Directors at its meeting on June 10th approved the following Rules for the award of the Adams Lecture:

1. The Committee on Awards shall act as a nominating committee to the Board of Directors for the selection of Lecturers to be invited to present the Adams Lecture.

2. The selection of the Adams Lecturers by the nominating committee and their approval by the Board of Directors should be guided by very thorough consideration of the individual, taking into consideration:

(*a*) His ability to prepare a truly scientific paper.

(*b*) His ability to present a lecture in an interesting and attractive manner.

(*c*) The facilities available to the individual for the preparation of a lecture involving some new and outstanding development in the field of welding.

3. The nominating committee shall propose two names to the Board of Directors, with recommendation as to priority, as suitable candidates for their consideration.

4. The Board of Directors shall take a written ballot on these candidates after discussion of the individual nominees. The one receiving the highest number of votes will be the individual selected as the Lecturer and the one who receives the second highest number of votes will become the alternate for the same year. The second individual designated as the alternate does not know that he has been selected as the alternate but in case the individual invited declines to accept, then the alternate automatically becomes the Adams Lecturer and the invitation is extended to him as though it had never been extended to the man who declined it. The individual selected should be asked for a reply within a two-week period from the time he is invited.

5. The selection of future Lectures should be made at a Board of Directors meeting which is more than 10 months in advance of the time of the Lecture. The individual should be selected a sufficient time in advance so that if he does not have subject material suitable for this Lecture he has the time in which to produce something worth while. It would be preferable to give at least a year and a half notice to the individual invited to present the Lecture.

6. An honorarium of $100 should be appropriated out of the funds of the Society each year, to be presented annually with the certificate. This sum does not represent compensation but is rather a token of the honor attached to the Lectureship.

ACTION BY BOARD OF DIRECTORS

Postponement of Publication Date of Year Book

The editor reported that consideration had been given to the advisability of issuing the Year Book as Part II of the February JOURNAL rather than Part II of the December JOURNAL, as heretofore, the purpose being to allow sufficient time for the preparation of the Year Book. Increased membership, labor shortage and a heavy load on the staff due to membership billing and Annual Meeting arrangements during the early fall make it impossible to have copy for the Year Book ready in time for the December JOURNAL.

On recommendation of the Publications Committee, it was voted to authorize the publication of the Year Book as Part II of the February JOURNAL each year, with the membership directory up to date as of November 1st, as heretofore.

STEEL WELDING WIRE DOUBLED '41 OUTPUT*

1942 Production Totaled 800,400,000 Pounds

Production of steel welding wire by the steel industry in 1942 reached approximately 800,400,000 lb., almost double the record output of 1941, when 453,120,000 lb. were produced.

The 1942 production, more than three times the output of welding wire in 1940, may be regarded as an index of the rising tempo of the war effort. Tremendous increases in the output of ships, tanks, aircraft and other welded articles of warfare were largely responsible for this huge output of welding wire.

For each ton of finished steel produced in 1942, almost 13 lb. of welding wire were made, compared with over 7 lb. in 1941, and 5 lb. in 1940.

In 1938, the year before the outbreak of war in Europe, about 4.9 lb. of welding wire were produced for every ton of finished steel products manufactured.

* Taken from *Steel Facts*, June 1943.

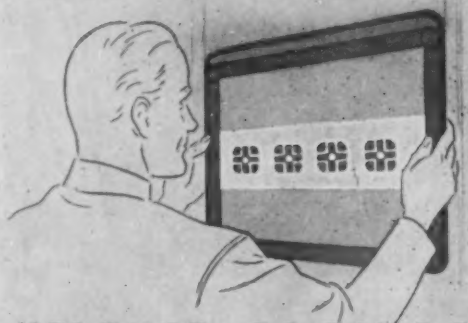
LUKENS OFFICES

C. T. Hansen & Co., for 12 yr. representative in Detroit, Mich., of Lukens Steel Co., has been appointed Pacific Coast Sales representatives of Lukens and subsidiaries, By-Products Steel Corp. and Lukenweld, Inc., Coatesville, Pa.

Offices have been opened by the Hansen Co. in Los Angeles, San Francisco and Seattle with C. T. Hansen, President of the company, who has established residence in San Francisco, in personal charge.

The offices are located in Los Angeles 14 at 628 Security Title Insurance Bldg. 530 W. Sixth St., in San Francisco 4, at 423–24 Russ Bldg., 235 Montgomery St., and in Seattle 1, at 6115–16–17 Arcade Bldg., 1319 Second Ave.

FOR LIGHT ALLOYS AND DIE CASTINGS



KELEKET PROVIDES BETTER THAN 5% FLUOROSCOPIC SENSITIVITY

Producers of light alloy castings will be interested in KELEKET'S Fluoroscopic equipment. Except in the few cases requiring film records this apparatus meets all requirements for X-ray inspection. ¶ The savings resulting from the elimination of film and processing costs are substantial.

ONE of our tanks is out of commission. What did it... an enemy bullet, shell, bomb? Perhaps. But it also could have been caused by some flaw in the construction... a structural weakness that only the test of battle brought to light. In either case, the result is the same... our tank is disabled, useless and out of action.

Flaws that may result in material failures often pass inspection because they are not detected by surface examination. However, inspection by X-ray removes this guesswork and reveals defects in the "inside" structure.

In many leading war plants KELEKET X-ray units are on the job detecting hidden flaws in critical materials ranging from thin aluminum sheets to heavy armor-plate... assuring our fighting men safer tanks, planes and ships.

A KELEKET Industrial Engineer will gladly consult with you and discuss the practical applications of X-ray inspection for your plant. There is no obligation.

KELLEY-KOETT X-RAY MFG. COMPANY
218-8 WEST FOURTH ST., COVINGTON, KY.

PIONEER CREATORS OF *QUALITY* X-RAY EQUIPMENT SINCE 1900

FLAME CUTTING HEAVY GEAR BLANKS

When a Long Island builder of derricks and hoists needed a small quantity of gears for the driving mechanism of several large cranes, he turned logically to flame cutting as the quickest method of making gear blanks of the size needed. The gear blanks, 4 in. thick and 20 in. in diameter, are cut from a large slab of medium carbon steel, then sent to an outside shop for machining of the gear teeth.

Five piercing starts are required on each gear, to provide four lightening holes and the center shaft opening. Piercing is done by first routing out shallow craters in the center of each waste section with a hand cutting torch, then buring these holes completely through with an oxygen lance. Cutting of the blank then proceeds, using an Airco Planograph with a magnetic tracing head following the outlines of a steel template.

As shown in the photographs the quality of cut is extremely good, The 4-in. deep cuts are made with a No. 6 tip, operating at 55 lb. oxygen pressure and 3 lb. acetylene. Speed of cutting is 7 in. per minute. A flame-cut hub is welded on to the finished gear blank before it is sent out for machining.

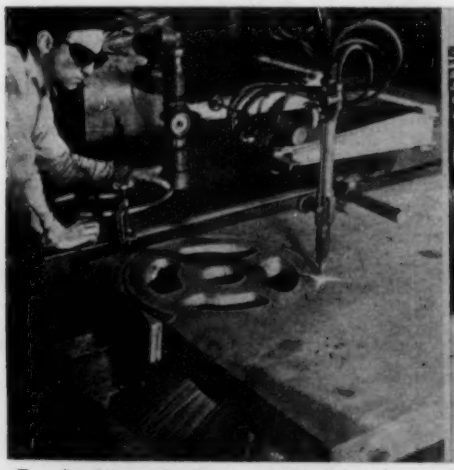


Fig. 1—Magnetic Tracer Guides the Torch Around Outer Periphery to Complete the Gear Blank

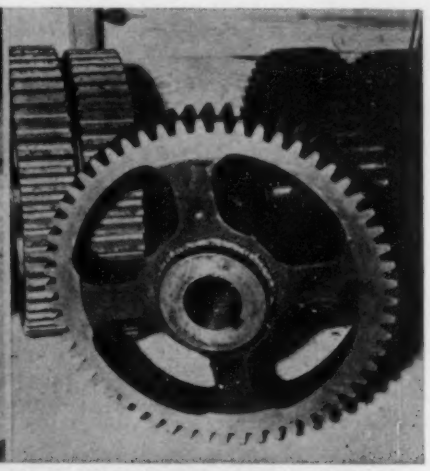


Fig. 2—Completed Gears After Machining. Flame-Cut Hubs Are Welded on

LINCOLN FOUNDATION AWARD STUDIES TO BE PUBLISHED IN BOOK FORM

New information on arc welding of great interest and value in war production and with many extremely important peacetime applications is soon to be made available by The James F. Lincoln Arc Welding Foundation in the form of a 1200-page book containing 98 of the outstanding award studies submitted in the Foundation's 1940–42 Industrial Progress Award Program, according to announcement made, in Cleveland, Ohio, by the Foundation on July 1st.

This timely volume, entitled, "Studies in Arc Welding," will make available the accumulated knowledge and experience of more than 100 engineers, designers and others applying themselves individually to a specific design study involving arc-welded construction.

AIR-COOLED POWER AND DISTRIBUTION TRANSFORMERS

New 4-page illustrated bulletin, No. 43-AT, describes the new type economical Eisler aircooled transformer, giving excellent service in restricted locations where safety against explosion and fire hazard are required. These transformers can be furnished up to 500 kva. in voltages to 4800 v. Illustrations of various models are shown and specifications are included. Eisler Engineering Co., Transformer Div., 740–770 So. 13th St., Newark, N. J.

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PAGE *Welding* ELECTRODES

Then you know how important it is that the metal deposited in the weld shall equal the Stainless you are welding. **PAGE** took away all uncertainty in that regard when they, in cooperation with the largest manufacturers of Stainless Steel, produced a complete range of **PAGE-ALLEGHENY STAINLESS STEEL ELECTRODES**—a range so complete that from it you can select the exact electrode for your work.

★ ★ ★

Because Stainless Steel stands so high on the list of critical materials, it is more than ever necessary to see to it that the electrode you are able to get will give you the proper metal in the weld. And it becomes even more essential to see that you get electrodes of the proper diameter and that your men waste none of them.

PAGE STEEL AND WIRE DIVISION

Monessen, Pa., Atlanta, Chicago, Denver, Los Angeles, New York, Pittsburgh, San Francisco, Portland

AMERICAN CHAIN & CABLE COMPANY, Inc.

BRIDGEPORT • CONNECTICUT

ESSENTIAL PRODUCTS . . . TRU-LAY Aircraft, Automotive, and Industrial Controls, TRU-LOC Aircraft Terminals, AMERICAN CABLE Wire Rope, TRU-STOP Brakes, AMERICAN Chain, WEED Tire Chains, ACCO Malleable Castings, CAMPBELL Cutting Machines, FORD Hoists, Trolleys, HAZARD Wire Rope, Yacht Rigging, MANLEY Auto Service Equipment, OWEN Springs, PAGE Fence, Shaped Wire, Welding Wire, READING-PRATT & CADY Valves, READING Electric Steel Castings, WRIGHT Hoists, Cranes, Presses . . . *In Business for Your Safety*

WAR PRODUCTION BOARD

PART 3175—REGULATIONS APPLICABLE TO THE CONTROLLED MATERIALS PLAN

[Direction 7 to CMP Reg. 5]

WELDING ROD

The following direction is issued pursuant to CMP Regulation No. 5 (§3175.5):

Welding rod (arc welding electrodes and gas welding rod) used for manufacturing purposes may not be treated as an operating supply under CMP Regulation No. 5 even though it is carried as an operating supply under established accounting practice.

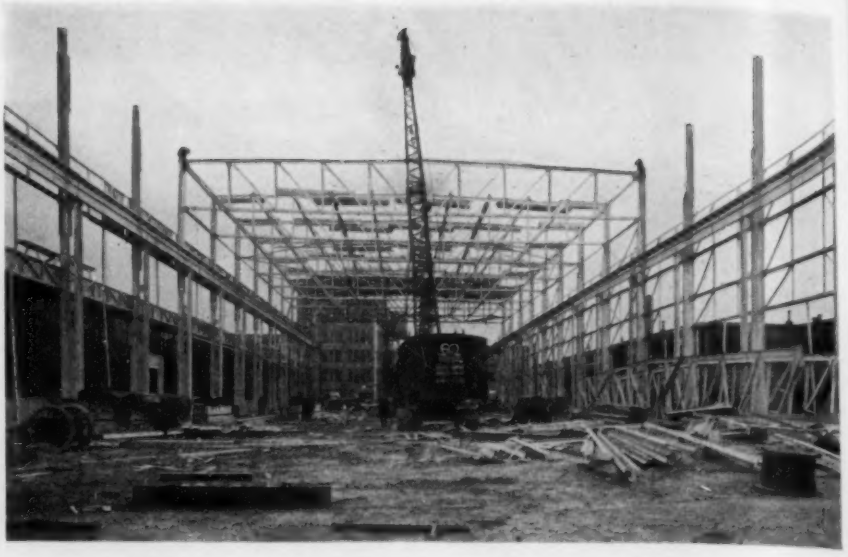
A manufacturer may use the rating assigned to him by CMP Regulation No. 5 to get his requirements of welding rod for repairing his own equipment. He may not use the rating to get his requirements of welding rod for welding operations in the course of producing his product.

Issued this 26th day of June 1943.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

WAR PLANT WELDED

With WPB orders prohibiting the use of steel in war plant construction still in effect, scenes like this, showing construction of the latest addition to Tube Turns' plant at Louisville, are mighty infrequent. The Austin Co., designer and builder of the plant, refabricated more than a hundred tons of wrought iron, salvaged when the old Louisville post office was razed recently, and an equal amount of used steel, for the framework.

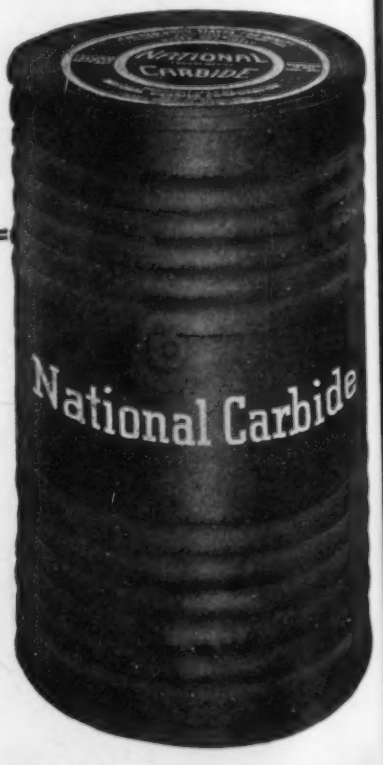


The wrought iron has been used in the truss webbing, bracing, eave struts, girts and stub columns, while the 43-ft. columns and top and bottom chords of the 80-ft. trusses were made from second-hand steel. All of the structural members were welded in the Austin shops at Cleveland and have riveted field connections. The wrought iron, originally produced more than 70 yr. ago, was found to be practically free of rust. While fundamental characteristics of the material called for special precautions in the design, the cross section conforms in all respects to a modern welded structure.

The only new steel in the structure is the 60-lb. crane rail, for which a priority was issued. The structure is 220 ft. long and has a clear span of 80 ft., with 35-ft. clearance below the trusses and 28 ft. below the crane runway. It is being equipped with a used 10-ton crane and is being enclosed with a wood roof and modern wood ventilating sash.

National
Carbide
IN THE RED DRUM

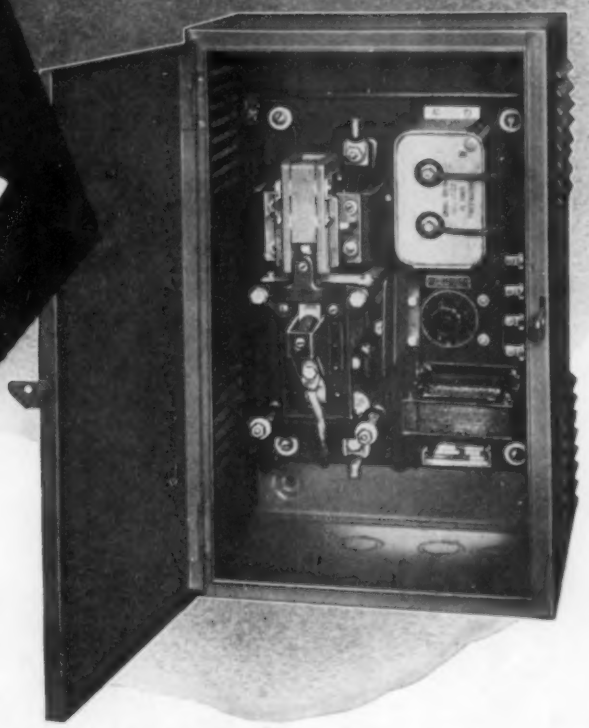
EFFICIENT
ECONOMICAL
DEPENDABLE



FOR WELDING and CUTTING
Use National Carbide in the Red Drum
60 E. 42nd St. NATIONAL CARBIDE CORPORATION New York, N. Y.

FOR HIGHER RATINGS AND LONGER CONTACT LIFE

SQUARE D SYNCRO-BREAK RESISTANCE WELDER CONTACTORS



Arcing is eliminated at the contact tips of *SYNCRO-BREAK* contactors by separately energizing the magnet "shading coil" from a transformer and rheostat circuit. Correct rheostat adjustment causes the contacts to part as the alternating current wave approaches zero. Thus, the contactor interrupts zero current and no arc is drawn.

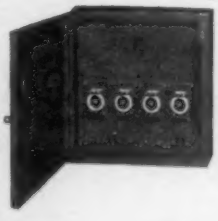
Elimination of arc heat at contacts increases allowable ratings and contact tip deterioration is reduced substantially. Rheostat adjustment is not critical and synchronization remains stable over long periods of usage.

Among the important mechanical design features which assure long, trouble-free service are: Hardened, knife-edge bearings for long life without lubrication. Solid contact supports to conduct away heat and relieve contact studs from impact strain. Low inertia moving parts and short contact gap, permitting consistent high-speed operation.

FOR FULLY AUTOMATIC CONTROL OF RESISTANCE WELDING MACHINES

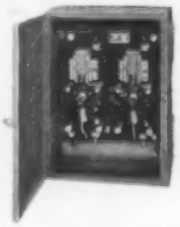
Use Safront Weld or Sequence Timers with SYNCRO-BREAK Contactors or HIGH-SPEED Contactors

Available in 18 NEMA standard types with separate pneumatic timing relays for each step of the welding cycle. All electrically energized parts are placed behind a protective panel. Calibrated timer dials are adjusted from the front.



Notice attractive new flat-door cabinet construction which harmonizes with Safront timers. This design allows more interior wiring space without increasing overall outside dimensions. Syncro-Break contactors are single pole only.

Available in either single or double pole, employing the same contactor construction as the Syncro-Break. High-Speed contactors without the synchronizing circuits are applied where operation is less frequent and loads are lighter.



ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

A MESSAGE FROM WOMEN SOLDIERS OF PRODUCTION FRONT

"A Message from the Women Soldiers of the Production Front" is the name of a new 12-page illustrated Book No. 1950 released by Link-Belt Ordnance Co., 306 West 37th St., Chicago, Ill.

It contains the interesting speeches of four women workers who were selected by women co-workers in the welding, machine shop, small-tools and assembly departments, as delegates to represent them at a monthly meeting of the plant supervisory group.

Pictures show the girls at work—and as they are when they are not working. For a copy of this book, write direct to the Ordnance plant address.

1943 A.S.T.M. DUDLEY MEDAL TO WALTER BONSACK

For his extensive technical paper published in the August 1942 *A.S.T.M. Bulletin*, Walter Bonsack, Chief Metallurgist and Director of Research Laboratories, The National Smelting Co., Cleveland, Ohio, was awarded the 1943 Dudley Medal of the American Society for Testing Materials at its meeting on June 30th. This award commemorates the name of the Society's first president, a pioneering materials technologist, and is made in recognition of technical papers of outstanding merit and constituting an original research contribution.

The paper entitled "Discussion of the Effect of Minor Alloying Elements on Aluminum Casting Alloys" gives critical discussion of the role which elements such as magnesium, manganese, nickel, tin, lead, bismuth, etc., play in various types of casting alloys.

WELDING CHARTS

As a means of aiding welders and burners to step up wartime industrial production, Victor Equipment Co., San Francisco and Los Angeles, is issuing two handy pocket-size charts, free, for use on any job.

These ready-reference charts present in tabulated form such items on cutting and welding as metal thickness, tip and drill sizes, oxygen pressure, consumption, gas pressure, acetylene cu. ft. per minute, cutting speed, length of flame cone, etc.

Copies of charts, Victor announces, will be mailed upon request.

NOMINATIONS FOR 1944 OFFICERS OF A.S.M.E.

Nominations for the 1944 officers of The American Society of Mechanical Engineers, which opened its Semi-Annual Meeting on Monday, June 14, 1943, were announced by Benjamin P. Graves, Chairman of the Nominating Committee, who is Director of Design of Brown and Sharpe Mfg. Co., Providence, R. I. Election of the nominees will be held by letter ballot of the entire A.S.M.E. membership of over 16,000 closing September 28, 1943.

Robert M. Gates, President of Air Preheater Corp., New York City, is the nominee for President.

Nominations for Vice-Presidents are David W. R. Morgan, Manager, Condenser Pump and Blower Div., Westinghouse Electric & Mfg. Co., Essington, Pa.; Jonathan A. Noyes, District Manager, Sullivan Machinery Co., Dallas, Tex.; Ford L. Wilkinson, Jr., Dean of Engineering, Speed Scientific School, University of Louisville, Louisville, Ky.; and Rudolph F. Gagg, Assistant to the General Manager, Wright Aeronautical Corp., Paterson, N. J.

Nominated as Managers are James M. Robert, Dean, College of Engineering, Tulane University, New Orleans, La.; Samuel H. Graf, Professor and Head of Mechanical Engineering, Oregon State College, Corvallis, Ore.; and Alton C. Chick, Assistant Vice-President, Manufacturers Mutual Fire Insurance Co., Providence, R. I.

VENTILATING ENGINEERS MEETING

The selection of New York City for the 50th Anniversary Meeting of the American Society of Heating and Ventilating Engineers is announced by President M. F. Blankin, Philadelphia, Pa. The dates chosen by the Council at its June meeting are January 31, February 1 and 2, 1944.

You're Never Caught Short
● With a Sight Feed Generator you never lose your heat in the middle of a job. You always have plenty of acetylene—never have to wait on delivery from a "bottler." And you cut acetylene costs up to 75%.
You see the "charge" in a Sight Feed and your acetylene supply is assured.
You operate any torch at any desired pressure with a Sight Feed Generator.
Sight Feed
GENERATORS
Made in a range of sizes—in portable and stationary models—for all shop and industrial service needs. Sight Feeds are listed for safety by UL and FM. Write for full information.
THE SIGHT FEED GENERATOR COMPANY
Sales: Richmond, Ind. Factory: W. Alexandria, O.

WELDING CHART OF CASTOLIN ALLOYS

A welding chart of Castolin Eutectic Welding Alloys has been prepared by the Eutectic Welding Alloys Co., 40 Worth St., New York, N. Y., and is available on request. The chart shows the type of welding alloy to use on each metal. Physical properties, temperature for welding color match, electrical conductivity and procedure for welding are all indicated on the chart.

CUTTING CROSSHEAD FROM 7-TON SLAB

Skillful applications of the oxyacetylene flame for heavy cutting are hardly out of the ordinary, but the cutting of the mammoth crosshead shown in the accompanying photo constitutes a major achievement in that it was shaped by a small gas-cutting machine, even smaller in scope than the size of the work piece.

This job was done by a Montreal structural steel plant, employing a planograph whose normal cutting range is 24 by 72 in. The crosshead measures 42 by 65 in. and is 20 in. thick. The 7-ton slab had to be cut in "installments." It was re-positioned several times during the cutting operation to bring first one end, then the other, and the central portion, into the motion range of the cutting torch. The slab was preheated to 400° F., and cutting was done with a water-cooled torch with a size No. 15 tip at 40 lb. oxygen pressure. Cutting speed was 3 in. per minute, all cuts being made on the 20-in. thickness.

Total time for setting up and cutting was only three hr., eliminating at least two weeks' rough machining operations. The quality of cut was remarkable. The crosshead was then annealed and after finish machining it was shipped to its destination via special train.

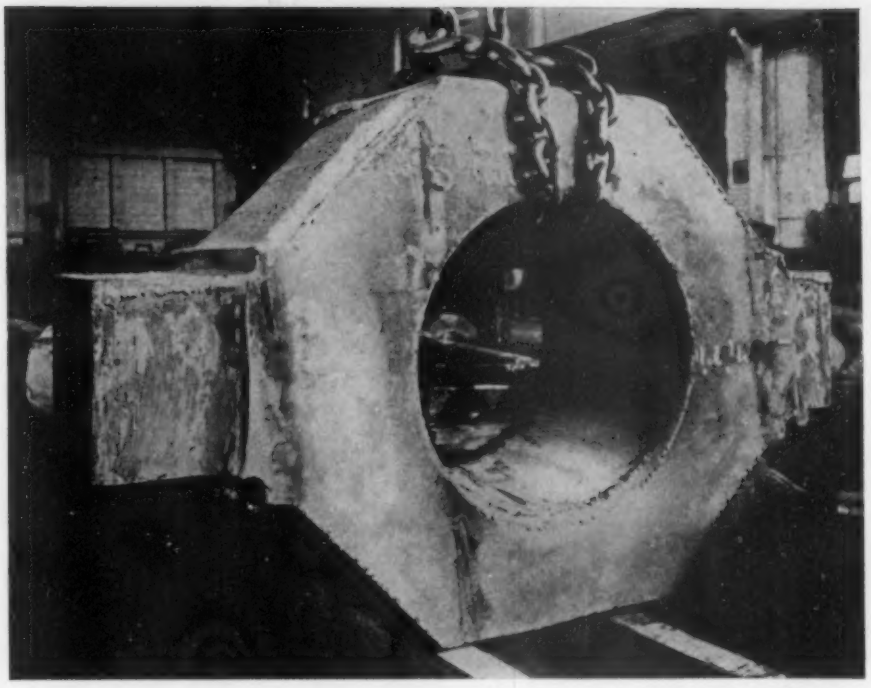
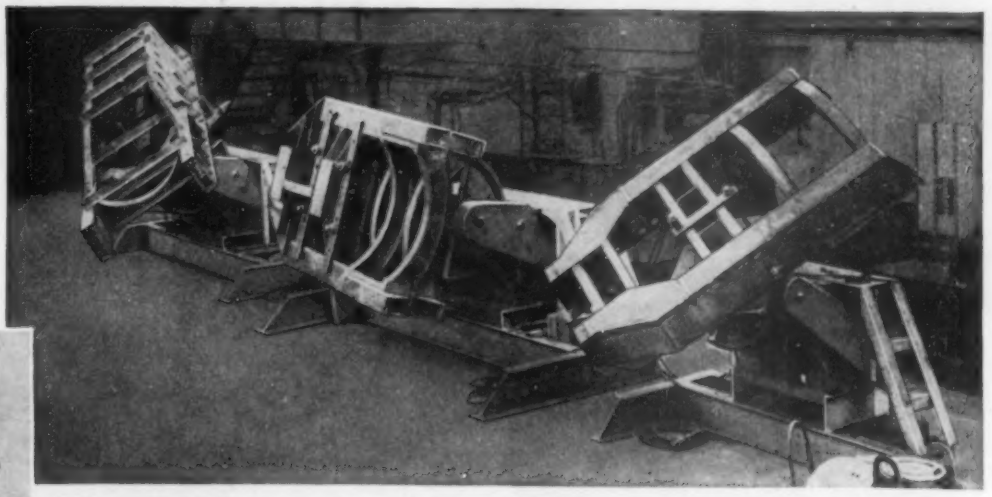


Photo courtesy Air Reduction Co.

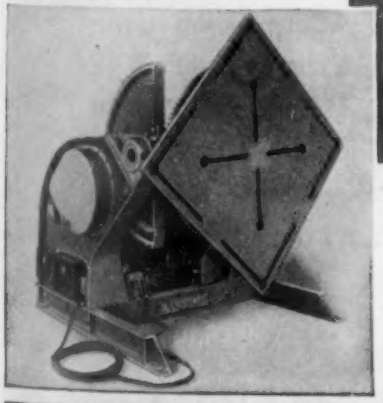
Flame-cut Crosshead After Annealing, Before Removal of Furnace Scale

POSITIONING PERMITS YOUR WELDERS TO CONCENTRATE ON WELDING...

In handling these cumbersome frame assemblies, the welders can swing them through 360° and tilt them as far as 135° beyond horizontal. Both men and women welders like Ransome equipment because it steps up their production and reduces fatigue.



6,000-lb. capacity unit.



It's certainly not good business to waste welders' time and energy in "rasseling" the work around . . . not when a Ransome Positioner will do the job at the touch of a switch.

This equipment improves quality by providing the correct downhand position for every weld, saves valuable floor space, promotes safety, and speeds up welding production generally.

There's a type and size for *your* welding needs . . . in a line that extends from light-duty hand-operated up to 40,000-lb. capacity.

» Write for full information.

Ransome WELDING POSITIONERS

INDUSTRIAL DIVISION • RANSOME MACHINERY COMPANY • DUNELLEN, NEW JERSEY

WELDED SHIP PROVES RELIABILITY OF CONSTRUCTION*

Production Communique #2 to North Carolina Shipbuilding Company, Wilmington, North Carolina quotes the following statement:

"I, Frank Maslany, Seaman, together with my comrades, Joseph Kosnsky, Folson and Vesta Smith, sailed on the S.S. William Moultrie, which was built by the North Carolina Shipbuilding Company in 1942. We picked up our cargo in June of 1942 and left America for the high seas.

On the way to Russia, we were bombed on ten different occasions. A ship carrying explosives was blown up right in our face. The concussion was so great it knocked everybody flat on their backs. The *Moultrie* was literally blown clear out of the water. It hit so hard coming down that it bounced back again. After the second bounce, the bow took a deep dive, leaving the stern high in the air, but she settled and righted herself, and later investigation proved that not a quart of water leaked through her seams during this severe strain. No direct hits were made on the *Moultrie* but near misses sprayed her with shrapnel.

This was the Battle of Spitzenbergen and we were attacked for ten days in succession by hundreds of torpedo planes operated by Heinies. When we finally got into Russia we got the biggest attack of all, while in the harbor. Each attack was followed by observation planes which invariably dropped two incendiary bombs before leaving our convoy. During these engagements our convoy shot down sixty-two enemy planes, the *Moultrie* accounting for more than her part.

We were in Russia two months. On November 17th, when the nights were long and the days short, we managed to steal away one very dark night. Our trip was uneventful as to enemy operations, but we encountered severe storms, giving the *Moultrie* a hundred different opportunities to prove her worth.

The boats built by the North Carolina Shipbuilding Company can take it; and I tip my hat to the men who build them. I believe so much in your boats that I'm back for more. I'm waiting now to sail on another of your ships. When asked if I thought she would prove as good as the *Moultrie*, I replied 'I had looked over the ship and I told my friend Joe—I said "Joe, she's better than the *Moultrie*. She's a Honey!" ' I want to sail on Liberty Ships built by the North Carolina Shipbuilding Company. You are doing such a good job here that I felt it my duty to come by and thank you because if the *Moultrie* hadn't been so well built, I wouldn't be here today talking to you.

(Signed) FRANK MASLANY"

* Submitted by A. F. Davis, Vice-President, Lincoln Electric Co., Cleveland, Ohio.

. . . . .

Recently Production Communique #6 was directed to the same company:

"U. S. Maritime Commission
Div. of Public Relations
March 22, 1943

"To the workers of North Carolina Shipbuilding Company
Wilmington, North Carolina

"Production Communique #6. Again your Liberty Ship, the *William Moultrie*, launched last May, has distinguished itself in a transatlantic convoy. In a running fight that lasted a week, its crew downed eight Nazi planes, damaged twelve, chased off a submarine and exploded a torpedo with a direct hit as the torpedo came toward their ship. Your ship, with its vital cargo of military supplies for an allied nation, reached its destination unharmed. Every worker in your yard can take justifiable pride in the accomplishment of your vessel and its crew. Keep up the good work. The *William Moultrie*'s victory is your victory.

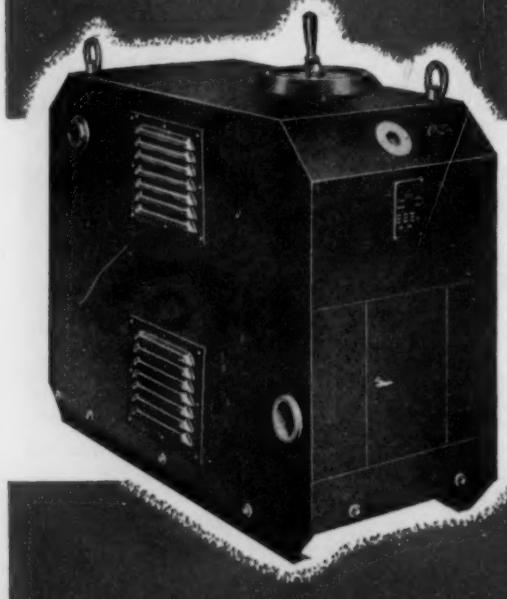
E. S. LAND, *Chairman*
United States Maritime Commission"

JEFFERSONVILLE BOAT AND MACHINE CO. RECEIVES ARMY-NAVY E

Two hundred years and five days after the birth of the author of the Declaration of Independence, a shipyard, located in an Indiana city named for him, inspired by a desire to perpetuate his principles, was awarded the coveted Army-Navy "E" because, in the words of Under Secretary of the Navy James Forrestal, the company and its employees "have accomplished more than seemed reasonable or possible a year ago."

Sunday, April 18th, at 3:00 P.M. Admiral E. L. Cochrane, Chief of the Bureau of Ships of the United States Navy, presented the Army-Navy "E" pennant to the Jeffersonville Boat and Machine

G-R 49
POWER FACTOR CORRECTED



A BEAR FOR PUNISHMENT!
...Readily adapted from Hand to Automatic Operation

YES, SIR, this husky new G-R 49 is the answer to today's heavy-plate welding problems, especially where hard-pressed plants need machines having the extra capacity to handle continuous loads.

Two open circuit voltages give wider welding application within its 100-675 ampere range. The G-R 49 *remains extremely cool*; even if its forced ventilation should become inoperative no damage will result. Contactor with push button control for power supply is provided. Get the facts first hand from your nearest G-R Distributor.

GLENN-ROBERTS COMPANY
1009 FRUITVALE AVENUE, OAKLAND, CALIFORNIA
2107 ADAMS STREET, INDIANAPOLIS, INDIANA
P. O. Box 1814, Washington, D. C.

WARTIME WELDERS AGREE

UNITED TUBES ARE TOUGH

AND LAST LONGER ON HARDEST JOBS

UNITED MERCURY RECTIFIER TUBE

972-A

(Interchanges with 872-A)

One of several industrial type electronic tubes widely used

Write for detailed engineering specification sheet

In shipyards, aircraft plants and tank factories—wherever toughest welding jobs are done—United 972-A's are loyal overtime workers.

On these tough proving grounds more and more engineers are choosing United tubes . . . for demonstrated high efficiency plus longer life.

It's an extra margin of ruggedness that makes each United 972-A last longer in use. Test after test proves that these finer tubes can "take it" under severe vibration and shock.

If you have not yet standardized on UNITED tubes for resistance welding, we suggest that you try them for your next replacement needs.

WHY UNITED INSURES LONG SERVICE LIFE

1. The protruded filament surface, mounted on a vertical plane, affords increased emitting area, while adding to the rigidity of the filament.
2. Greater shielding than is found in ordinary types of tubes. Proper relation between condensed mercury and ambient temperature is maintained. The large cylindrical element shields the filament adequately, yet permits required thermal radiation for extended life in service.

Our local jobber in your city can obtain UNITED 972-A's for you on properly rated orders placed reasonably in advance of your actual needs. Ask him to order for you, or write us direct.

UNITED ELECTRONICS COMPANY

NEWARK NEW JERSEY

Company, a firm which less than two years ago was a small yard engaged in constructing and repairing American Barge Line towboats and barges.

Admiral Cochrane, speaking during a lull in the intermittent rain, told an audience of 11,000 assembled on the outfitting docks that "the Jeffersonville Boat and Machine Company is the first of the smaller inland shipyards to tackle a major shipbuilding job for the Navy, is the first inland yard to be awarded the "E" for outstanding production of war materials since I was appointed Chief of the Bureau of Ships, and certainly deserves every honor the Army and Navy can bestow upon it."

"IDEA STIMULATOR"
For New Design or Re-design by Arc Welding

A new data service in loose-leaf form titled "Practical Design for Arc Welding" is being released by The Hobart Brothers Company of Troy, Ohio, manufacturers of Electric Arc Welding Equipment. It is a new design and suggestion service, replete with time-saving suggestions for economical design of changeovers or new products.

In order to stimulate the staff of every company as they attack reconstruction problems in Production, Processing, Construction and Maintenance of Equipment, The Hobart Brothers Company engaged Mr. Robert E. Kinkead, one of the best-known independent welding consultants in the country, to prepare a series of design suggestions based on his actual experience in many industries. Mr. Kinkead has had many years of practical experience and field contact with welding in its various phases and applications and he realizes the primary importance of coordinating the elements of design, available materials and available equipment for handling and preparing the materials.

The loose-leaf format, to fit standard files or binders, is being used so that the service may be readily adapted to the individual user's preference. These new sheets will offer suggestions that will be of such universal application that the matter of size and detailed specifications are left open—so that such details are to be determined by the designer in each case, to meet the requirements of the purpose at hand.

Many designers of general industrial equipment have developed great skill and ingenuity in solving their problems with welded designs. Among designers it has been found that it is often helpful in getting started on a job to see what other designers have accomplished with welded design, even though the other's work may have been done in an entirely different line of equipment. *This series of sketches is intended to fill that need.*

The first section of this new service is now being released to a selected list of firms and individual executives who can make the best possible use of the new ideas for the benefit of their business. By writing to The Hobart Brothers Company, Troy, Ohio, immediately, all manufacturers interested in this service will be automatically enrolled to receive future plate titles as they are issued. Name and title of the individual who can best make use of these suggestions for design should be given.

Employment Service Bulletin

POSITION VACANT

V-125. Welding Research Engineer. Need a man with practical experience in welding who can help with the development of coated welding rod ingredients.

V-126. Sales Department needs Development Engineer. Man must have good working knowledge of how metal parts and equipment are fabricated. Experience in welding, brazing, soft soldering on a production basis would be valuable. Man should be 30 to 40 years of age.

SERVICES AVAILABLE

A-461. Welding Engineer-Supervisor. Years of practical experience, specializing in Fusion Welding and Cutting. Available soon.

WHY PAY MORE? NATIONAL "SEEMWELDO"

A WELDING TIMER THAT CONTROLS CURRENT

FOR THE MOST DIFFICULT SEAM WELDING OPERATIONS

FULLY SYNCHRONOUS — VARIABLE SPEED, DIAL SET FOR WELD TIME CHANGE, and MOST IMPORTANT—IT PROVIDES HEAT CONTROL IN 45 GRADUAL STAGES,—ALSO BY DIAL SET.

If You Want Low Heat for Stainless, or High Heat for Commercial Steel, You Get It Instantly, by Turning a Graduated Dial Knob. If You Want Longer Weld Time, but Less Off Time, another Dial will Provide This, in ½ Cycle Steps.

It is Simple, Rugged, and Really Accurate.

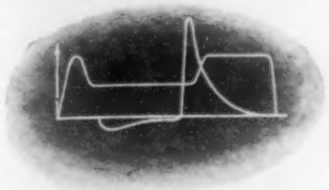
Type 1871 SEEMWELDO, as Illustrated, Lists Complete at $380.00

SEEMWELDO operates in conjunction with your Ignitron Tube Contactor, and connects Directly into the Tube Firing Circuit. It is Motor Driven, start and stop, and employs NATIONAL patented 'Drop-to-make' followed by 'Drop-to-break', Precision Cam Control. It is Power Factor Corrected, and the Firing Point on the Sine Curve is Selected in relation to the amount of Current, or Heat Desired for the Welding Operation.

NATIONAL TIME & SIGNAL CORPORATION

600 E. MILWAUKEE AVENUE DETROIT, MICHIGAN

HELPING TO SOLVE TODAY'S WARTIME PRODUCTION PROBLEMS



the problem of spot-welding heavy gauges

ON ALUMINUM AND LIGHT ALLOYS

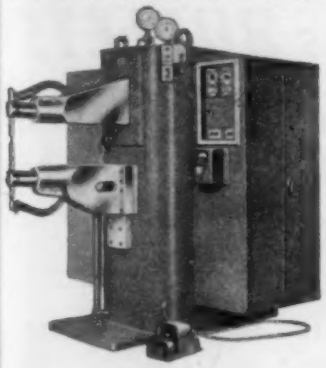
It is not generally recognized that the spotwelding of heavy gauge aluminum on a production basis is being successfully accomplished today. Many leading aircraft manufacturers are speeding up the fabrication of heavier assemblies by employing the Sciaky Process of Electric Resistance Welding.

Inasmuch as the difficulties involved in the spot-welding of aluminum increase proportionately with the increase in thicknesses used, the advantages of the Sciaky Stored Energy Principle and Variable Pressure Cycle can be readily seen. The extremely high current requirement is compensated for by the use of Stored Energy, which effects high power factor, uses less current and balances the three-phase supply.

The tremendous pressure required is obtainable by the use of a special, heavy duty head using two cylinders. These can operate either on the Variable Pressure Cycle or at constant pressure. When both cylinders are operated at constant, the maximum pressure can be made as high as 12,000 lbs.

Exhaustive tests have demonstrated the ability of the Sciaky 240 KW machine to weld satisfactorily two thicknesses of .156" aluminum in production. Under proper conditions, two thicknesses of .187" aluminum can also be fabricated by this method.

★ ★

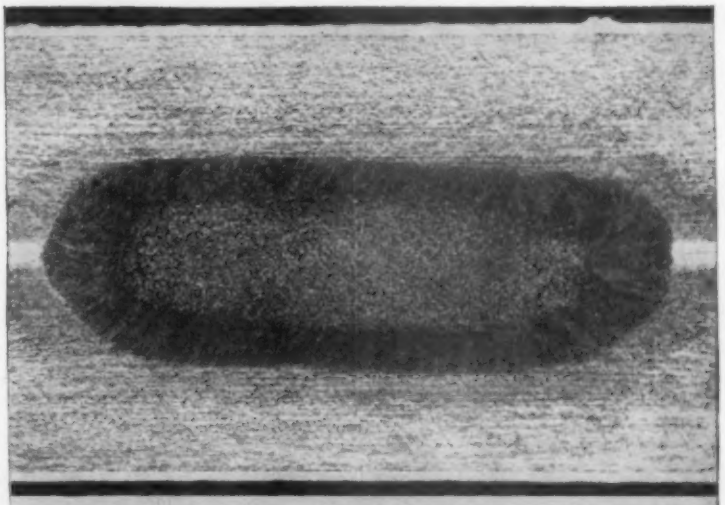


TYPE PMCR2S-5 SCIAKY ELECTRIC RESISTANCE ROCKER ARM WELDER, with built-in rectifier, welding 70 spot welds per minute on two sheets of aluminum alloy of .040" each. Welding capacity: from two thicknesses of .016" in aluminum alloys up to and including .080".

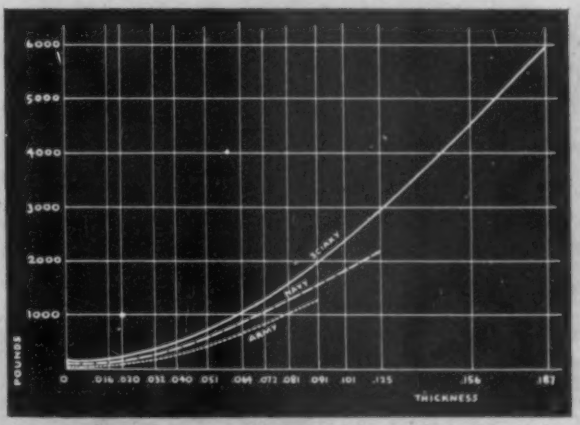
SCIAKY BROS.

Manufacturers of a Complete Line of A.C. and D.C. Electric Resistance Welding Machines.

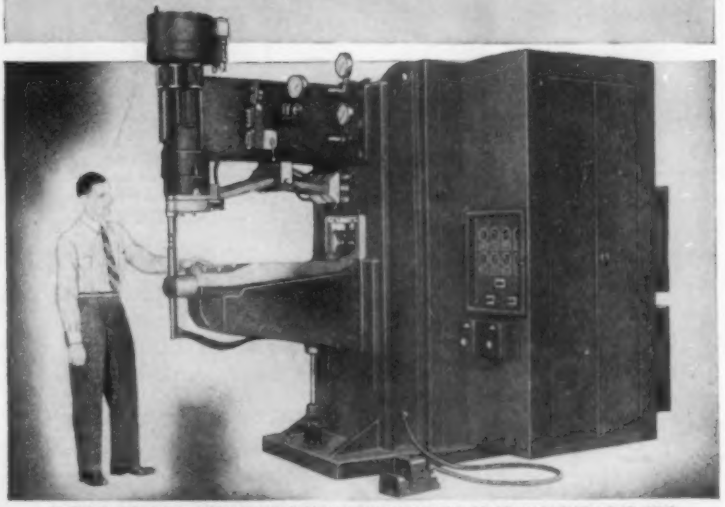
4915 W. 67TH ST. • CHICAGO, ILLINOIS



UNRETOUCHED MACROPHOTO of a typical Sciaky spot weld on .156" plus .156", 24ST Alclad at 14X Mg., indicates the weld nugget of proper penetration, and a central zone of uniform cast structure surrounded by an even columnar zone. Good grain structure with no porosity and the absence of cracks is also evident.



A comparison of Army and Navy Minimum Shear Test Values and the range of Sciaky Machines.



TYPE PMC05S-1 SCIAKY ELECTRIC RESISTANCE SPOT WELDER, 240 KW. Welding capacity: aluminum and other alloys or corrosion resisting steels in thicknesses of from .040" plus .040" minimum up to and including .187" plus .187" maximum. Speed: 40 spot welds per minute on two thicknesses of .040" of light alloys.

LACK OF WELDING ROD FAILS TO STOP OUR NAVY

From a letter to the editor of "Hobart Arc Welding News" recently received from Edward J. Tuckett, Shipfitter 1st Class, U.S.N., with the Fleet somewhere in the Pacific, comes this interesting bit of news of repairs and maintenance of equipment going ahead in spite of shortages of necessary materials.

We quote from Mr. Tuckett's letter as follows:

"Out here on the other side of the world where replacement parts are next to impossible to get and equipment might be tied up for 2 or 3 months waiting for parts to arrive, we fully realize the valuable assets we have in our gasoline engine-driven arc welders. We encounter plenty of jobs that, back in the States, we would consider impossible to put back into shape, but somehow we discover some way of repairing a broken or worn piece of equipment and soon it is ready for duty again. When you understand thoroughly the circumstances under which we work and some of the things we have to work with, it is really unbelievable the work we accomplish.

"While on one of our repair trips through the jungle, we were called upon to rebuild five teeth that had been sheared off a small gear on a commutator shaft. Unable to remove the shaft, we wrapped the commutator with sheet asbestos to protect it during the welding. We then discovered that we didn't have any welding rods to do the job with, so I set the welding machine reverse polarity and used bare steel rods to build up the teeth. As these teeth were too soft to last long, we dressed them with a file and then welded a small bead of Stellite on the surface. 'Believe ir or not,' it works perfectly, and the entire job was accomplished in 3 hr. I am sending this bit of news to you with the hope that it may be of help to others in a pinch.

"I am looking forward to the day when we can all return home and swap our many trade yarns with each other, so until then, I remain,

Sincerely yours,
E. J. Tuckett, S.F. 1/c U.S.N.
Navy-206-C/O Fleet P.O.
San Francisco, California"

SAM TOUR & CO., INC.

On and after June 30th, the metallurgical laboratories that were established by Sam Tour during the 14 years he has been Vice-President and Chemical and Metallurgical Engineer in charge of the Engineering Departments of Lucius Pitkin, Inc., now located at 45 Fulton St., New York, will be operated as the laboratories of Sam Tour & Co., Inc.

Lucius Pitkin, Inc., will continue as before as analysts, assayers, chemists, consultants, spectroscopists, weighers and samplers, and shippers representatives catering to the mining and metallurgical industries.

The main office and laboratories of Lucius Pitkin, Inc., will continue in the Pitkin Bldg. at 47 Fulton St., New York.

Sam Tour & Co., Inc., will take over the work as consultants, engineers, metallurgists, metallographers, radiographers, research development and testing laboratories for the many clients previously served by the discontinued departments of Lucius Pitkin, Inc.

Sam Tour & Co., Inc., with main offices at 65 Pine St., and laboratories at 45 Fulton St., New York, will specialize in the metallurgical, chemical and process engineering fields.

The facilities of Sam Tour & Co., Inc., will be unique in scope, to meet the ever-expanding needs of metallurgical, chemical and process engineering. The complete metallurgical laboratory at 45 Fulton St., adjoining the Pitkin building, occupies several floors and includes equipment for melting, casting, heat treating, machining, testing, electroplating, finishing welding, fabricating and examining of metals.

WELDING POSITIONER BULLETIN

A new bulletin, No. 196, illustrating and describing the 2500-lb. capacity hand-operated Welding Positioner has just been released by the Industrial Division, Ransome Machinery Company, Dunellen, N. J. Copies may be obtained by addressing the company.

WRITE FOR CATALOG

We manufacture a complete line of resistance spot welders from ¼ to 300 KVA for all types of welding. There is an EISLER WELDER for every purpose.

TRANSFORMERS OF ALL TYPES

WE INVITE CONTRACT SPOT WELDING IN LARGE OR SMALL QUANTITIES.

CHAS. EISLER
EISLER ENGINEERING CO.
779-SO. 13th ST. Near AVON AVE NEWARK, 3 N. J.

BRASS MAKES BULLETS

REGO Gas Plant Equipment to be safe, must be made of brass and other critical metals.

Conserve equipment—You may not get more.

The BASTIAN-BLESSING Co.
4241 W. PETERSON AVE. CHICAGO
Pioneers and Manufacturers of Precision Equipment for Using and Controlling High Pressure Gases

The bomb fin that came to our welding lab... and got a 1400-ft. lb. sock on the nose!

BEFORE—Spotwelded bomb fin in position under a special drop-impact testing machine.

AFTER—Specimen after taking the shock of a 198-lb. weight dropped from 7 feet.

ARMY engineers wanted to know if a certain type of steel could be spotwelded successfully to form fins for 1000-pound bombs. They wanted to know if these fins could stand rough handling, and especially if they would keep their strength in the extreme cold of high altitudes.

So our research men undertook to find out. Several actual spotwelded bomb fin assemblies were used as test specimens, most of them refrigerated with dry ice to 40° below zero. Each fin cup was submitted to punishing blows under a 198-pound armor plate weight, falling from a height of 7 feet in a special drop impact testing machine—a 1400-ft. lb. shock.

As you can imagine, some of the specimens were thoroughly squashed. But all the spotwelds held! We found out what we wanted to know —that the bomb fins could be mass-produced economically by spotwelding low-cost steel, with adequate strength to withstand all stresses.

So another U·S·S welding test added its facts to our growing reservoir of fabricating information — a reservoir that is always "on tap" for you. This welding service is an important extra advantage that goes with any U·S·S Rolled Steel you may fabricate. Complete, laboratory-proved welding data are easily available to you promptly and without the slightest obligation.

U·S·S Rolled Steels for Welding Include:

U·S·S High Tensile Steels to resist corrosion and increase strength without adding weight.

U·S·S Copper Steels to give twice the atmospheric corrosion resistance of regular steel at little additional cost.

U·S·S Abrasion-Resisting Steel to combat wear and friction.

U·S·S Stainless and Heat-Resisting Steels to assure high resistance to corrosion and heat, and to reduce weight.

U·S·S Carilloy Alloy Steels—Special steels for the special jobs of industry.

U·S·S Hot-Rolled and Cold-Rolled Steels to provide the basic advantages of steel, plus maximum economy in accordance with the requirements of each job.

U·S·S ROLLED STEELS FOR WELDING

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*

United States Steel Supply Company, Chicago, *Warehouse Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

ELECTRONIC CONTROL OF RESISTANCE WELDING

Electronic Control of Resistance Welding, by George M. Chute, Application Engineer, General Electric Co., Detroit, an unusually simple and practical manual, fully explaining the tubes and circuits used to control resistance welders in industrial plants, for the aid of men who work with and maintain these controls. The book describes electron tubes and their circuits, giving simple electrical background along with detailed explanation and diagrams of most tube circuits, including synchronous timers and stored energy controls. It shows how and why the tubes work in their circuits, in a treatment that starts with the picture of the complete welder control in service and adds detailed fundamental background as the need arises in the study of specific devices. Price $4.00. Published by McGraw-Hill Book Co., Inc., New York, N. Y.

WELDED PRECIPITRON CELLS

Workman atop the 18-ft framework is making the final weld before setting in banks of Westinghouse Precipitron cells which will remove particles of dirt from the air being sucked into a huge turboblower in the power house at the new Kaiser Co. steel mill near Fontana, Calif. This is said to be the first time in steel mill history that an electric air-cleaning apparatus has been used to keep the rotor blades free from sludge formation, thus

reducing maintenance work and enabling more efficient operation. Air intake shutters are shown in the background of the photo, through which 90,000 cu. ft. of air per minute will pass when the installation is complete.

UNIFORM BUILDING CODE

1943 Edition. $2.00 per copy. Published by Pacific Coast Building Officials Conference, 124 West Fourth Street, Los Angeles, Calif.

The *Uniform Building Code* is dedicated to the development of better building construction and greater safety to the public, through the elimination of needless red tape, favoritism and local politics by uniformity in building laws; to the granting of full justice to all building materials on the fair basis of the true merits of each material; and to the development of a sound economic basis for the future growth of cities through unbiased and equitable dealing with structural design and fire hazards. Reference is made to the 1941 Edition of the AMERICAN WELDING SOCIETY Code for arc and gas welding in building construction, although the design values are of the 1937 edition.

SUSTAINING MEMBERS

Marinship Corp., Sausalito, Calif., has been in existence since March 1942. The yard is turning out Liberty ships and tankers for the U. S. Maritime Commission, the first contract calling for 15 Liberty ships. Thirteen of these have been delivered and two more are being completed. A new contract now calls for 22 tankers in 1943 and 42 in 1944. Five of the 1943 tankers have already been launched and are at the Outfitting Docks at Marinship.

The T-2 tankers are much larger than Liberty ships—16,500 tons and 10,000 hp. turbo-electric drive. The first nine tankers will go to the U. S. Navy as Fleet "oilers."

Alloy Rods Co., York, Pa., manufacturers devoted exclusively to the production of corrosion and heat-resisting arc-welding electrodes. They also manufacture all types of 19–9 modified electrodes for the arc welding of Army, Navy and Aircraft armorplate. Recent plant expansion and newly designed equipment provide this company with the largest production capacity in the country for the exclusive manufacture of alloy electrodes.

SPEED UP WITH

SHAWINIGAN CARBIDE

SHAWINIGAN

SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BLDG., NEW YORK

Just off press!

ELECTRONIC CONTROL of RESISTANCE WELDING

By George M. Chute
Application Engineer, General Electric Company
389 pages, 6 x 9, 152 illustrations
$4.00

AN unusually simple and practical manual explaining fully the electron tubes and circuits used to control resistance welders in industrial plants. Will aid men who work with and maintain these controls, and the electrical maintenance man without technical training. Includes simple electrical background, along with detailed explanation, diagrams, of most tube circuits. Covers synchronous timers and stored energy controls.

Order from
American Welding Society
33 W. 39th St., New York 18, N. Y.

Is this YOUR Cleaning Problem?

How to Recondition Your Flame Cutting Tips Easier

For reconditioning fouled gas welding and flame cutting tips EASIER and FASTER, try the NEW, SAFE Oakite method specially designed for this work.

You will find it not only helps you SAVE TIME and CONSERVE MANPOWER by eliminating the need of manual buffing and scraping, but also speedily and thoroughly removes ALL tarnish, scale, slag and carbon without harming orifices. Write today for NEW FREE, 2-page Special Service Report giving complete details.

OAKITE PRODUCTS, INC., 18E Thames St., NEW YORK
Technical Service Representatives Conveniently Located in All Principal Cities of the United States and Canada

OAKITE Buy Bonds for Victory **CLEANING**

How to Weld New Life Into Worn Pump Rods and Shafts

Worn pump rods and shafts of Monel or other critical materials can be rebuilt to their original size by welding.

Usually employed to recondition shafts larger than 1½" diameter, welding may be used on shafts as small as ½" diameter.

The welding process, if carried out in the following manner, will produce a rebuilt shaft that is high in strength, toughness and stiffness:

The surfaces to be built up must be clean. Foreign substances such as greases, corrosion products and particles of packing should be removed by rough machining, grinding, filing, or wire brushing.

Downhand welding is best for reconditioning shafts. The electrode is held at an angle of about 20° from the vertical, ahead of the puddle. This permits control of the molten flux and eliminates slag trapping.

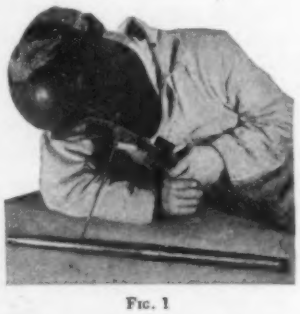


FIG. 1

A short arc (24-27 volt) should be maintained during welding. The recommended electrode diameter and current ranges for different sizes of shafts and rods are listed in table at top of next column.

Distortion of the pump shaft is controlled by keeping the welding heat low, and by laying down the welding beads longitudinally in sequences as shown in Figs. 2 and 3. This tends to equalize the effects of heating and cooling. Each weld should be cleaned of flux and wire brushed before the adjacent bead is laid. The size of the beads and the welding speed should be uniform.

ELECTRODE DIAMETERS AND CURRENTS

Shaft Size	*Welding Electrode*	*Current Range*
	130X Monel Electrode	
Dia. inches	Dia. inches	Amps.
½	.075 or 3/32	25-40 or 45-60
¾	3/32 or ⅛	45-60 or 60-95
1	⅛	60-95
1½ or larger	5/32	80-150

The completed weld build-up is clean and solid, with close-knit and uniform rows of beads overlapping each other. After being built up, the shaft is machined and finished to its final dimensions.

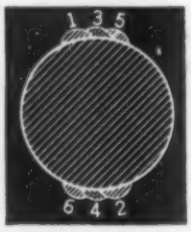


FIG. 2 — *Sequence for laying down welding beads on shafts 2-inch diameter and smaller.*

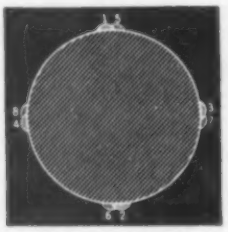


FIG. 3 — *Sequence for laying down welding beads on shafts larger than 2-inch diameter.*

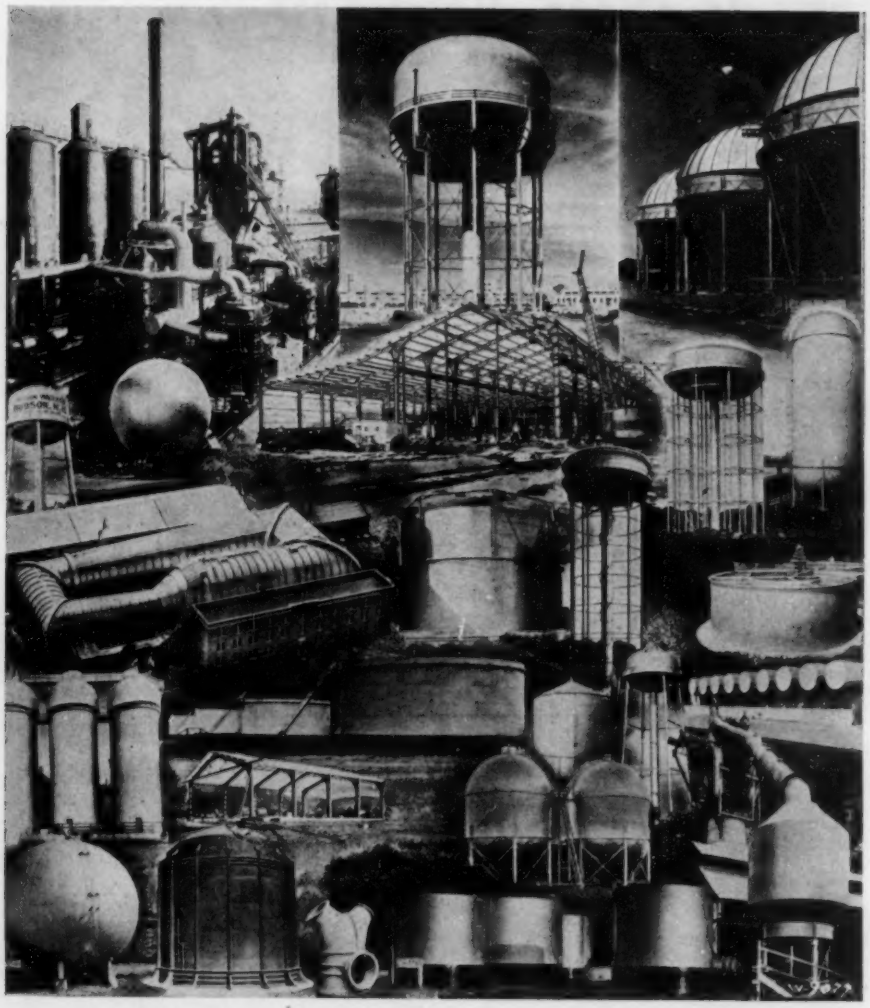
Questions concerning the reclamation of equipment by welding should be addressed to INCO's Technical Service.

Copy of an article "How to Recondition Worn Pump Shafts and Rods," giving further details of welding and other reconditioning processes . . . will be sent on request. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

★ ★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings



THE APPLICATION OF WELDING TO THE STRUCTURAL AND TANK FIELD

Courtesy Pittsburgh Des Moines Steel Company, Pittsburgh, Pennsylvania, and The Lincoln Electric Company, Cleveland, Ohio.

The tremendous importance of electric arc welding in the design and fabrication of structures built for war production as well as for peacetime use is typified in the accompanying composite photograph which illustrates arc welding's spectacular versatility as applied to structural development and progress in the industrial fields.

OFFICE OF WAR INFORMATION UNITED STATES MARITIME COMMISSION

The Nation's shipyards delivered 168 cargo vessels totaling 1,676,500 deadweight tons in June, the Maritime Commission announced on July 2nd. The number may be compared to the record total of 175 for May (31 days), and 157 ships delivered in April (30 days).

The June figures brought the total production for the first half of 1943 to 879 ships aggregating 8,818,622 deadweight tons. In the entire year 1942 the yards produced 746 vessels totaling 8,089,732 deadweight tons.

June construction brought a new record for ships delivered by an individual yard. The California Shipbuilding Corporation sent 20 Liberty Ships into service compared with 18 delivered in May and 19 in April. The Shipbuilding Division of the Permanente Metals Corporation of California turned in a total of 25 Liberties; these were built in the former Richmond Yards Nos. 1 and 2 which until recently were run as separate yards. In the future they will be run as one.

Other high totals turned in included 14 Liberty Ships by Bethlehem-Fairfield Shipyard, Baltimore, Md., and 17 Liberties by the Oregon Shipbuilding Corporation, Portland, Ore.

The total of 168 vessels included 115 Liberty Ships, 19 C-type cargo ships, nine coastal cargo vessels, 11 M. C. tankers, three coastal tankers, three special types, six sea-going tugs and two ore carriers.

The West Coast region produced 82 ships totaling 870,800 deadweight tons, or 51.94% of the national total. The East Coast built 30.39% of the tonnage, or 509,400 deadweight tons represented by 45 vessels. On the Gulf Coast 25 ships with combined deadweight tonnage of 237,800 were delivered, accounting for 14.18% of the grand total. The remaining 3.49% of the tonnage was delivered from Great Lakes region yards which built 16 ships.

The number and types of ships built by all the yards follow:

Shipyard	No. of Vessels	Type of Vessel
Alabama Dry Dock & Shipbuilding Co. Mobile, Ala.	1	Tanker
American Shipbuilding Co. Cleveland, Ohio	1	Ore Carrier
Barnes-Duluth Shipbuilding Co. Duluth, Minn.	3	Coastal Tankers
Bethlehem-Fairfield Shipyard, Inc. Fairfield, Baltimore, Md.	14	EC2 Cargo
Bethlehem-Sparrows Point Shipyard, Inc. Sparrows Point, Md.	1	C-3 Cargo
California Shipbuilding Corp. Wilmington, Calif.	20	EC2 Cargo
Consolidated Steel Corporation, Ltd. Wilmington, Calif.	7 1	C-1 Cargo Special Type
Delta Shipbuilding Company, Inc. New Orleans, La.	5	EC2 Cargo
Federal Shipbuilding & Dry Dock Co. Kearny, N. J.	1	C-2 Cargo
Froemming Brothers, Inc. Milwaukee, Wis.	1	Sea-Going Tug
Great Lakes Engineering Works River Rouge, Mich.	1	Ore Carrier
Globe Shipbuilding Company Superior, Wis.	2	Sea-Going Tugs
Houston Shipbuilding Corporation Houston, Tex.	7	EC2 Cargo
Ingalls Shipbuilding Corporation Pascagoula, Miss.	3	C-3 Cargo
J. A. Jones Construction Company, Inc. Brunswick, Ga.	2	EC2 Cargo
J. A. Jones Construction Company, Inc. Panama City, Fla.	2	EC2 Cargo
Kaiser Company, Inc., Swan Island Portland, Ore.	4	Tankers
Leathem D. Smith Shipbuilding Company Sturgeon Bay, Wis.	1	Coastal Cargo
Marinship Corporation Sausalito, Calif.	1	Tanker
Moore Dry Dock Company Oakland, Calif.	2	C-2 Cargo X-17587
New England Shipbuilding Corporation South Portland, Me.	8	EC2 Cargo
North Carolina Shipbuilding Company Wilmington, N. C.	9	EC2 Cargo

SAVE BRONZE WELDING RODS!

Castolin Eutectic LOW TEMPERATURE WELDING

LATEST DEVELOPMENT IN CAST IRON WELDING

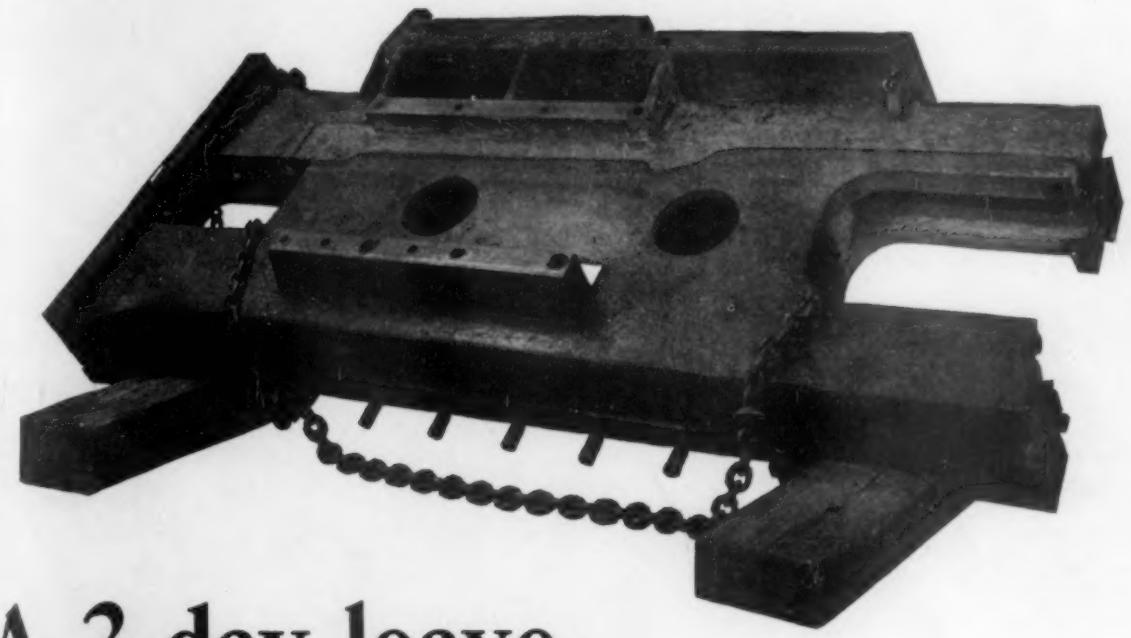
NO. 14 -- GAS WELDING NO. 24B -- AC-DC METALLIC ARC

Machinable • Color Matching • No Stresses • No Distortion

AVAILABLE ON PRIORITY A-9

Write for Welding Data Book E2

EUTECTIC WELDING ALLOYS COMPANY • 40 WORTH STREET • NEW YORK



A 3-day leave instead of 10 months A.W.O.L.

Thanks to Bronze Welding

Out of action for some ten months might well have been the fate of this cast iron column of a press producing 75 mm. shell cases. For that's about how long it would take to get a replacement these days.

But bronze welding came to the rescue. Although the 8-ft. high, 6-ton heavy casting had cracked for a distance of 7 feet, the fracture was quickly repaired in the shop by the Super Arc Welding Company, Detroit, Mich. 20 man-hours for preparation, 48 man-hours for welding, 400 lbs. of Tobin Bronze* Welding Rod—and the column was back on the job. That was nearly a year ago. Today, the repaired press is still giving a good account of itself—instead of making shell cases—pressing out an important motor part for army trucks and armored cars.

For speedy, wartime repair welding, never overlook the advantages of such rods as Tobin Bronze and Anaconda 997 Low Fuming. For complete information, write for the new edition of Anaconda Publication B-13. 4306

*Reg. U. S. Pat. Off.

BUY MORE WAR BONDS FOR VICTORY

ANACONDA

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

Oregon Shipbuilding Corporation Portland, Ore.	17	EC2 Cargo
Pacific Bridge Company San Francisco, Calif.	1	Coastal Cargo
Pusey and Jones Corporation Wilmington, Del.	1	C-1 Cargo
Pendleton Shipyards Company, Inc. New Orleans, La.	2	Sea-Going Tugs
Pennsylvania Shipyards, Inc. Beaumont, Tex.	2 1	C-1 Cargo Sea-Going Tug
Permanente Metals Corporation (Richmond Shipyard No. 1) Richmond, Calif.	8	EC2 Cargo
Permanente Metals Corporation (Richmond Shipyard No. 2) Richmond, Calif.	17	EC2 Cargo
Kaiser Company, In. (Richmond Shipyard No. 3A) Richmond, Calif.	2	Special Type
St. Johns River Shipbuilding Company Jacksonville, Fla.	2	EC2 Cargo
Southeastern Shipbuilding Corporation Savannah, Ga.	2	EC2 Cargo
Sun Shipbuilding and Dry Dock Company Chester, Pa.	5	Tankers
Walsh-Kaiser Company, Inc. Providence, R. I.	2	EC2 Cargo
Walter Butler Shipbuilders, Inc. Superior, Wis.	7	Coastal Cargo
Western Pipe and Steel Company San Francisco, Calif.	2	C-3 Cargo
Total	168 vessels	

OUTSTANDING 1943 A.S.T.M. ANNUAL MEETING

Many Actions on Standards; Research Work Discussed; Extensive Technical Papers

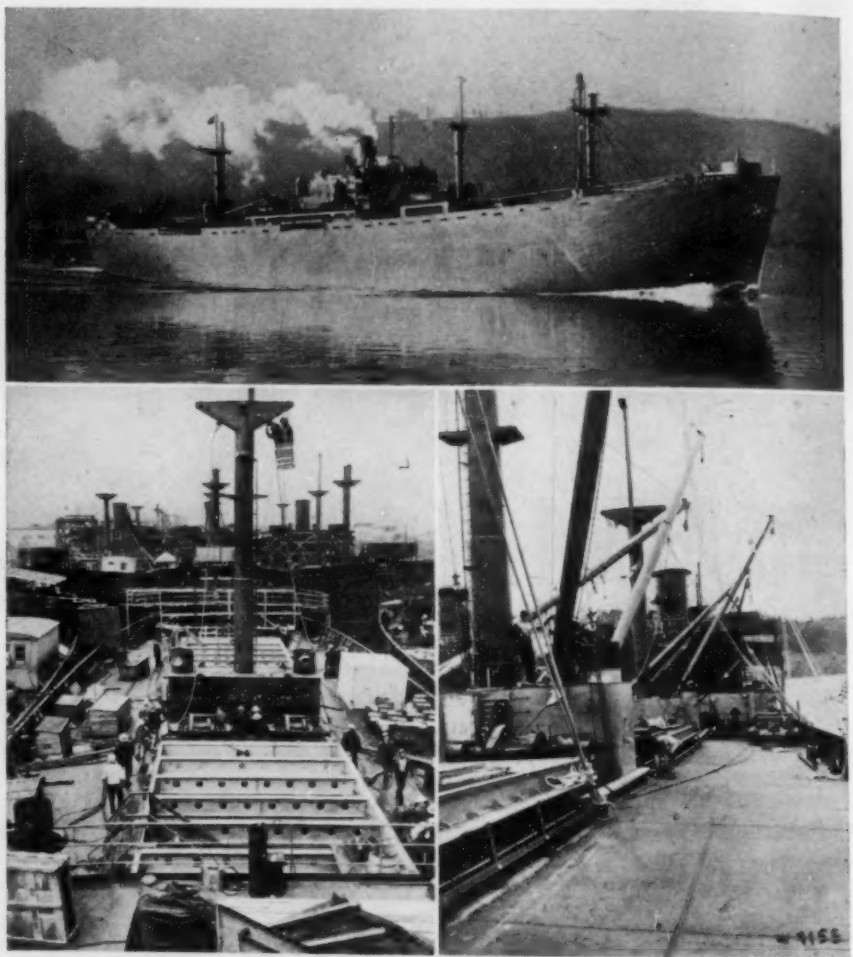
With a registered attendance of 1452 members, committee members, and guests attending the meetings, and 245 technical committee meetings at each of which there was excellent attendance of members, and an interesting technical program of papers and reports in the fields of both metals and non-metals, the Forty-sixth Annual Meeting of the American Society for Testing Materials held in Pittsburgh, June 28 through July 1 was outstanding. The attendance was the third highest ever recorded at a meeting, exceeded only by the 1937 meeting in New York, and the 1941 meeting in Chicago (registered attendance, 1553).

WELDED SHIP WITHSTANDS SEVERE DAMAGE

To the builders of the *Edgar Allan Poe*, an all-welded cargo vessel, recently went this telegram:

"To the Workers of Oregon Shipbuilding Corp.—Production Communique No. 3. The *Edgar Allan Poe* ship you built has done magnificent service. Struck by an enemy torpedo amidship its crew stood their guns and continued to blaze away at the Jap submarine until it was sunk. The entire engine room of your ship was damaged, steam and fuel pipes ruptured, lower decks lifted and great damage done throughout the midship structures. But the bulkheads held. No water reached any cargo space. The vessel was later towed to port with its entire cargo intact. Two seamen gave their lives so that your ship with its vital war matériel would reach our fighting forces in the South Pacific. The performance of the *Edgar Allen Poe* is a credit to every worker of the Oregon Shipbuilding Corp. and I know you will take pride in its accomplishment.

E. S. Land, *Chairman*,
United States Maritime Commission."



Courtesy The Lincoln Electric Co.

U.S.S. Edgar Allen Poe During Construction and on Her Trial Run

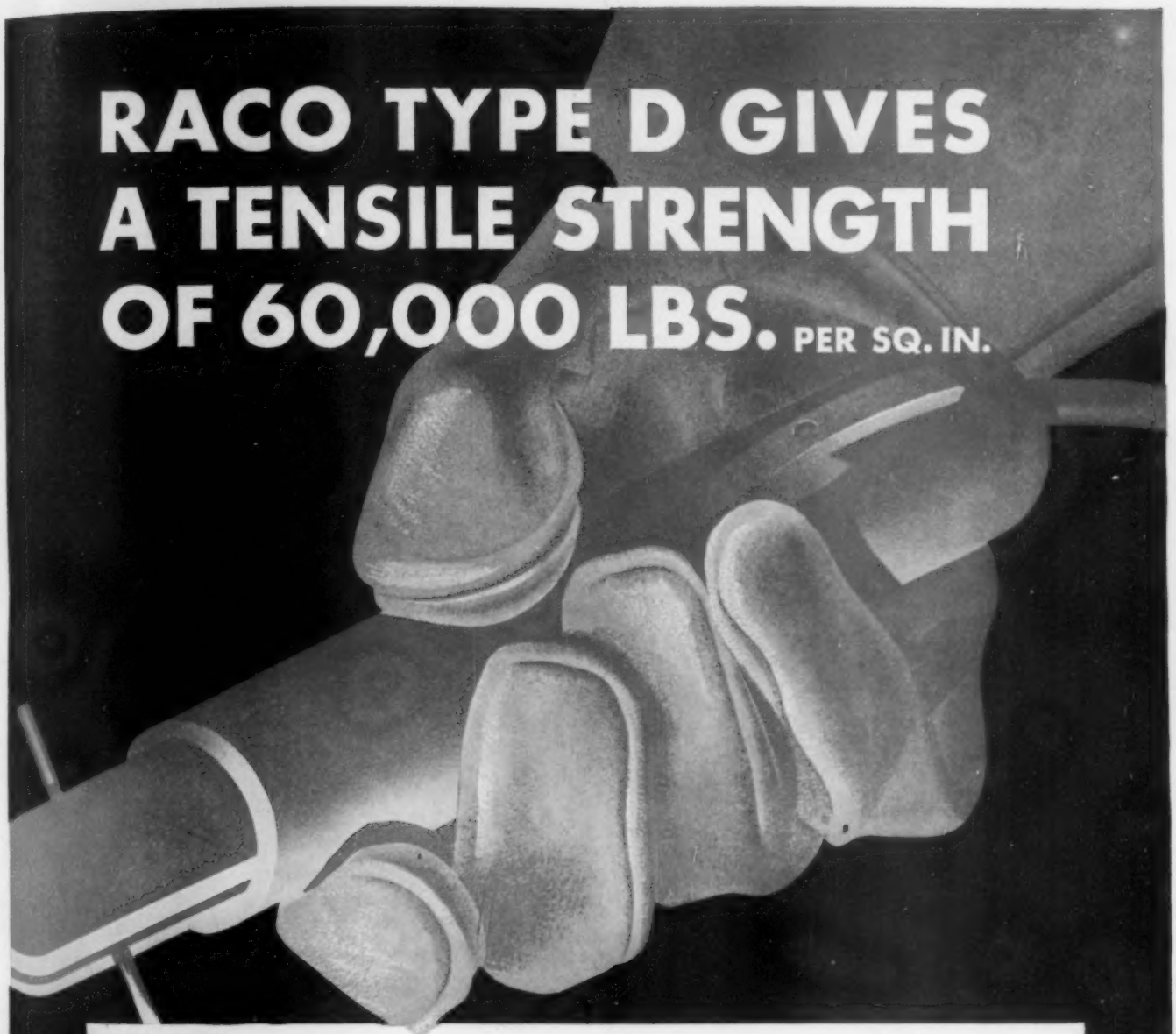
MALLORY STANDARDIZED WELDING ELECTRODES

SPEEDIER PRODUCTION
LESS DOWN TIME
BETTER WELDING
LOWER COST

Spot welding speeds plane production. Seam welding speeds shell production. Flash and butt welding speed tank and jeep production. Mallory tips and holders, wheels and dies speed resistance welding all along the production front. Write today for your free copy of the factual Mallory Resistance Welding Data Book.

P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA • Cable Address — PELMALLO

RACO TYPE D GIVES A TENSILE STRENGTH OF 60,000 LBS. PER SQ. IN.



Instead of wondering where and when you can get Shielded Arc Electrodes . . . why not try RACO Type D Composite Electrodes?

RACO Type D has been used for over ten years by the largest automobile manufacturers . . . on hundreds of jobs . . . both automatic and manual . . . where high speed is vitally important and high stress is not a factor.

But tests have proved that a tensile strength of 60,000 pounds per square inch is obtainable with RACO Type D Composite Electrodes . . . far more than is required for most sheet metal work . . . and more than sufficient for many types of general welding of mild steel for storage tanks, range boilers and similar purposes.

The REID-AVERY COMPANY

DUNDALK, BALTIMORE 22, MARYLAND

RACO SHIELDED ARC ELECTRODES

We are accepting orders for deferred delivery on:

RACO TYPE H-D No. 5 for deep groove welding in flat position AC or DC

RACO TYPE H-D No. 6 for fillets flat and positioned machine and plate construction AC or DC

RACO TYPE H-D No. 7 for all position, general construction—shipbuilding. DC Reverse Polarity

RACO TYPE H-D No. 8 for all position, general purpose, single pass, building up wearing surfaces, low carbon. DC Straight Polarity or AC

Samples and Literature on Request

OFFICE OF ALIEN PROPERTY CUSTODIAN

In view of the steadily growing demand for licenses under patents seized from enemy owners, Alien Property Custodian Leo T. Crowley recently announced liberalized terms for the issuance of licenses to American business by his office.

Beginning August 1, 1943, the fee for obtaining a license to use enemy owned patents held by the Alien Property Custodian will be a flat $15 for each patent. Hitherto, licenses have been issued for a fee of $50 for a single patent plus $5 for each related patent included in the same license.

The new arrangement, Mr. Crowley said, will make it easier for small manufacturers to put single patents promptly to work. It also will more equitably compensate the APC for work involved in searching out contractual agreements that already exist on specific patents.

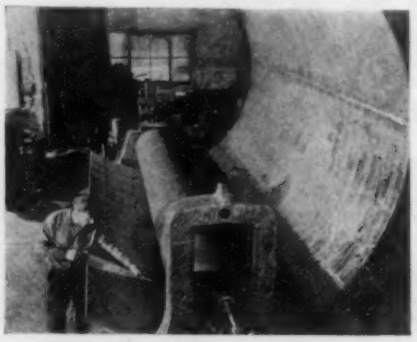
Main effect of the change will be to streamline procedures necessary to put seized patents to work in American industry. In the past considerable time has had to be devoted to determining whether several patents covered by a single application were in a 'related' field. Under the new system the class similarity of patents covered by an application will not have to be considered.

Information concerning the 40,000 patents and patent applications now held by the Alien Property Custodian can be obtained by addressing the Office of Alien Property Custodian, Field Building, Chicago, Ill. Except for those patents which already were exclusively licensed to American industry prior to seizure, patents which formerly belonged to enemy nationals are now available under license on a non-exclusive, royalty-free basis for the life of the patents.

Mr. Crowley reiterated that in accordance with his understanding with the President, no patents or patent application held by him as Alien Property Custodian are offered for sale. Nearly all, however, are freely available under the liberal licensing policy of the APC.

MAKES BIG PLATES FROM LITTLE ONES

Unable to get single plates to specification for large motor-generator and turbine wrapper sheets, General Electric welds smaller pieces together for the purpose at its Schenectady Works. Plate shown being bent to proper curvature consists of four sections joined by three arc-welded seams, two of which are visible at right. Edges of the one-inch plate were first prepared by machine gas cutting to provide a double V-joint. Half the weld is deposited from one side, and the plates turned over. The root of the first half of the weld is chipped out and the second half of the weld completed. The



weld is then chipped off flush with the plate so it will pass through the bending rolls smoothly.

SPLICING 18-IN. BEAMS BY ARC WELDING*

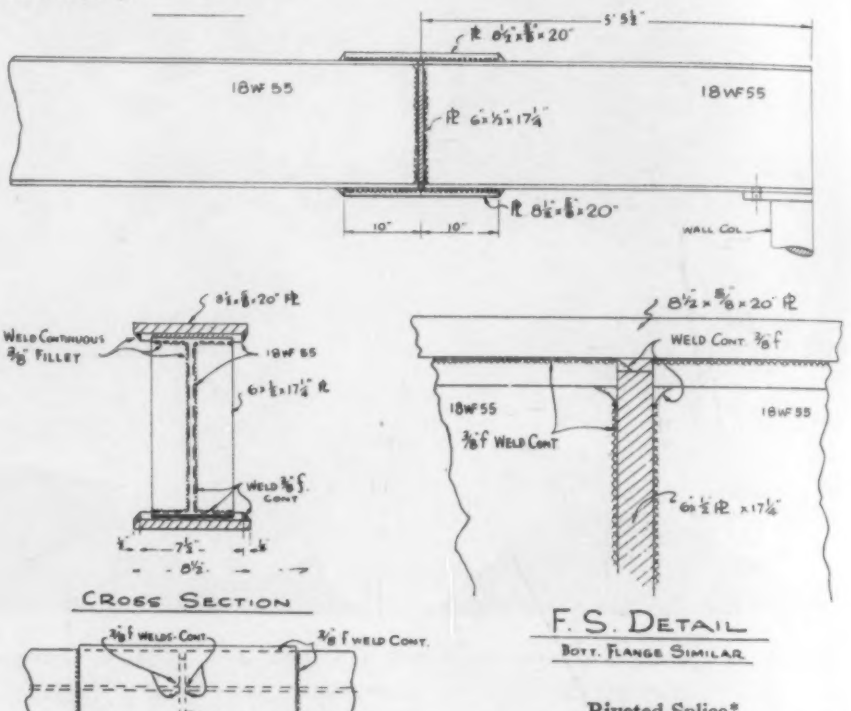
Unable to purchase 18-in. beams of the length required for one of their projects, the County Iron Works, Port Chester, N. Y., was forced to use some of the shorter pieces of 18-in. beams they had on hand and devise a quick and economical manner of splicing them together to meet the requirements of the new job.

Fred Horowitz, welding operator at the County Iron Works plant, submitted a detail of the welded splice and received the architect's approval to proceed at once.

In comparison with riveting, this work was done at a surprisingly low cost and the architect was very much pleased at the neat and finished appearance of the work. No after treatment was necessary.

In submitting his notes on cost of welding over riveting, Mr. Horowitz says, "To the best of my knowledge, I have never seen or heard of this type of splice for the beam web which permits a double weld, thereby having double strength."

Comparison of costs (job consists of splicing 18 WF# girders):



Riveted Splice*	
Material, inc. 60 rivets	$ 7.00
Labor	23.00
Total	$30.00
Welded Splice	
Material	$ 3.50
Rods	.50
Labor	5.00
Total	$ 9.00

* The previous method used for splicing which required punching each member.

The above splices were made using a 300-ampere Hobart welder and 5/32-in. coated electrodes.

* This article was one of the prize-winning entries submitted in the Hobart Arc Welding News Contest.

ELECTROLOY ALLOYS for RESISTANCE WELDING ELECTRODES and DIES

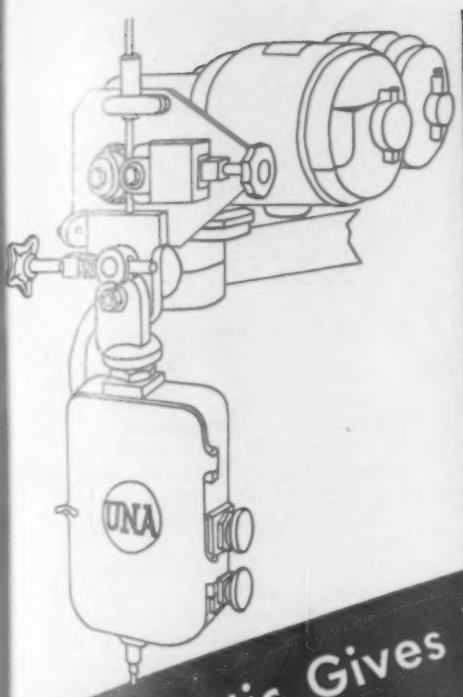
Spot
Seam
Butt
Flash
Projection

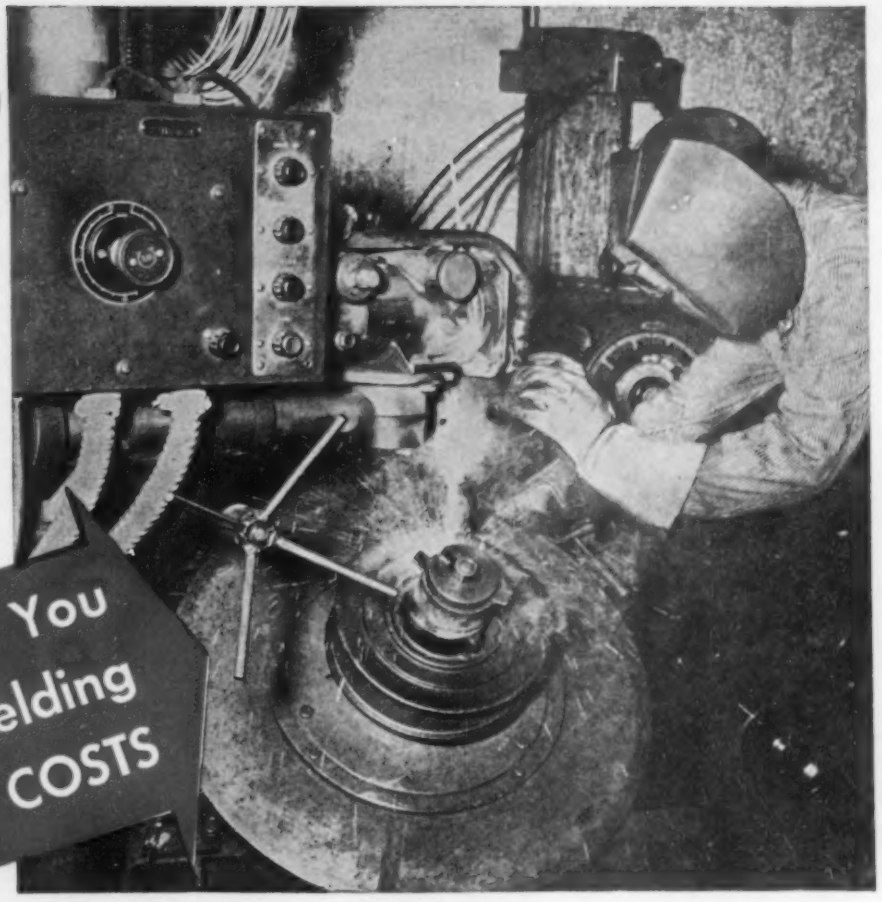
ELECTROLOY ALLOYS were developed specifically for the resistance welding industry. ELECTROLOY ALLOYS cover the full range of physical properties necessary to the manufacturers and users of resistance welding equipment.

Our engineers will be glad to make recommendations for your special electrodes. Submit samples or specifications.

Catalog and prices available on request.

THE ELECTROLOY COMPANY, Inc. 1600 Seaview Avenue, BRIDGEPORT, Connecticut



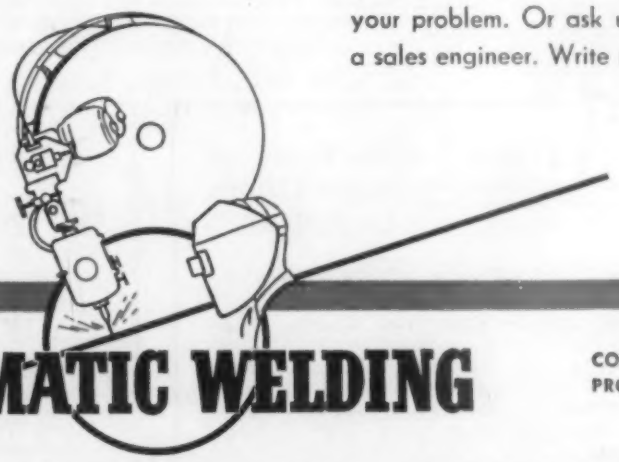


Unamatic Gives You Faster, Better Welding WITH LOWER COSTS

CIRCUMFERENTIAL welds as small as two inches in diameter or straight welds 240 times as long indicate the range of application of Unamatic Welding equipment. Wherever it is applicable Unamatic Welding is faster or better or cheaper than manual operation and usually it is all three.

Unamatic Welding gives you two big advantages—a continuous, uninterrupted pass and closely controlled quality. Once you decide the most practicable set-up and fit-up for the job, Unamatic equipment and materials insure you exact repetitive duplication. Your costs on production work can be figured closely without risk.

Right now Unamatic shielded arc and light coated welding has hundreds of different applications in war production. To find out the quickest way, how you can use faster and better Unamatic Welding, tell us your problem. Or ask us to send a sales engineer. Write now.



CONTROLLED QUALITY

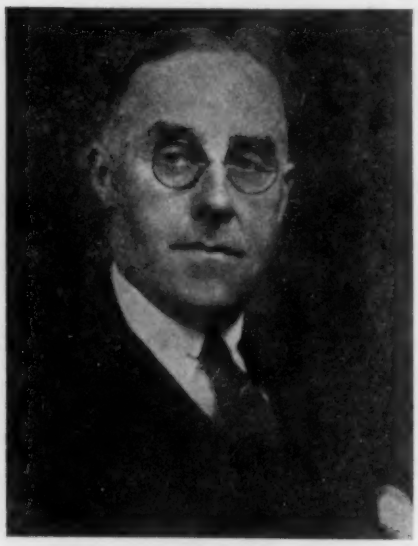
UNAMATIC WELDING

CONTINUOUS PRODUCTION

UNA WELDING INC. • 1615 COLLAMER AVE. • CLEVELAND, OHIO

LEACH HONORED

The John Price Wetherill Medal was awarded to Robert Howland Leach, Vice-President of Handy & Harman, "In consideration of his development and perfection of silver alloys applicable for the brazing of similar and dissimilar metals and exhibiting in the molten state marked properties of fluidity and wetting qualities



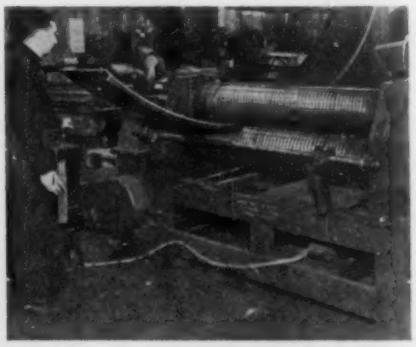
R. H. Leach

and in the solid state producing a joint exhibiting, in the light of the low melting point, outstanding ductility and strength."

Mr. Leach is a Sustaining member of the SOCIETY and assisted in the preparation of material for the 1942 edition of the *Welding Handbook*.

GROOVED BENDING ROLLS SPEED SHEET-METAL OPERATIONS

Sheet-metal operations have been speeded up at General Electric's Schenectady Works through the use of grooves in a standard 6-ft. bending roll. The grooved rolls were devised by members of the company's welded products section. In combination with the use of spot welding instead of arc welding, they have reduced the time required to produce such products as end shields, ventilating hoods and covers for motor generators and turbines.



The spacing of the grooves provide certain combinations of channel and Z-sections. Flat sheets are sheared to proper length and developed width, and the edges are then bent in a standard bending brake to form either a channel or Z. Next, the two ends of the piece are formed in a brake to the contour of the desired part. Then the piece is inserted into the grooves of the roll, and by applying pressure to the top roll the section is rolled to the desired contour. This rolled section takes the place of a Z-section formerly made from either two or three pieces arc welded together.

The rolled section is then routed to a spot welder where it is spot welded to flat side sheets. The use of spot welding produces neater work in less time and at lower cost.

FIRST WOMEN'S ARC-WELDING CHAMPION DECLARED

Winner of the first National Women' Arc-Welding Championship Contest held recently was blue-eyed Vera Anderson of Ingalls Shipyard, Pascagoula, Miss., who defeated Mrs. Hermina Strmiska of Kaiser's Oregon Shipbuilding Co. in Portland.

In a roped-off "ring" at the Ingalls yard, the girls "fought it out" on flat, vertical and overhead welding tests while being "seconded" by veteran Ingalls welders. Pretty Miss Anderson's victory netted her $350 in War Bonds, a massive silver loving cup, a week-end trip to the White House in Washington and title of "Queen" of the welding world.

Courtesy Ingalls Shipbuilding Corp.

Left—Vera Anderson and Mrs. Hermina Strmiska Start the Vertical Test in "Round 2" of the Championship Encounter

Right—The Pretty Blue-Eyed Winner, Miss Anderson, with Her Welding Superintendent, W. B. Bowen, Resting Between "Rounds" on One of the Welding Machines Used in the Contest

Buy "Proven Fluxes" with Years of Guaranteed Satisfaction behind them
The Trade-Name is "ANTI-BORAX"

Ask for Them ***Unequalled for Quality***

A Flux for every metal: Cast Iron Welding Flux No. 1; Brazing Flux No. 2; Braz-Cast Flux No. 4, for bronze-welding cast iron; "ABC" Aluminum Flux No. 8 for sheet Aluminum and all alloys of Aluminum; Stainless Steel Flux No. 9; Silver Solder Brazing Flux No. 10.

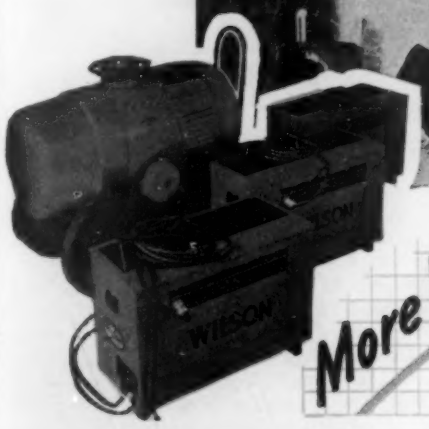
ANTI-BORAX COMPOUND COMPANY
Fort Wayne, Indiana

NET MONTHLY ADVERTISING RATES

Black and White *Effective April 1943*

Space	One Insertion	Three Insertions	Six Insertions	Twelve Insertions
*Full Page	$120	$105	$95	$85
Half Page	70	60	55	50
Quarter Page	42	38	35	30
Eighth Page	30	25	20	18
*Inside Preferred	135	120	110	100

*10% Extra for bleed full pages. Color $40 Extra per color added.



More Welding-Better Quality Welds with the "WILSON HONEY BEE" ARC CONTROL STATION

TWO or more "Honey Bees," connected to any constant potential arc welding generator, increases the number of welding arcs that can operate simultaneously from a single welding machine.

At the same time the "Honey Bee" assures better welds on light gauge metal – thanks to Wilson Remote Crater Control. Craters, porosity and similar defective welds are prevented because Crater Control permits the operator to fade out the arc slowly – never breaking it abruptly.

Each operator using a "Honey Bee" station has full control over his welding current. A switch conveniently held in the operator's hand enables him to regulate his current while welding to any value (from zero to maximum) within the full range of the "Honey Bee" station. Changes in current setting do not affect the performance of any other "Honey Bee" stations working from the same generator.

The Wilson "Honey Bee" is available in two sizes – 75 amps. and 150 amps. For complete details get in touch with your nearest Air Reduction sales office. A descriptive bulletin ADW-47 will be forwarded on request.

Metal deposited with standard welding machine and no crater control.

Metal deposited with Wilson "Hornet" equipped with "Honey Bee" Remote Arc and Crater Control Station.

Photo courtesy of Curtiss-Wright Corporation.

WILSON

WILSON WELDER and METALS CO., INC.

General Offices: 60 East 42nd Street, New York, N. Y.

NEW PRODUCTS

The Society assumes no responsibility
for the validity of claims in this Section

MAGNETIC CLAMP SPEEDS SHIP CONSTRUCTION

The Sweetland Magnetic Clamp for positioning welded members is announced by Glenn-Roberts Co. of Oakland and Indianapolis, makers of G-R Welders, who will manufacture and distribute the new device. The clamp is an electromagnetic tool, designed for shipyard use but applicable by adaptation to a wide variety of uses.

Sweetland Magnetic Clamp, Type B, Shown in Ship Fabrication Holding Two Stiffeners to Deck Plate, Enabling Flanger to Keep Two Welders Busy

Note absence of saddles or other devices requiring temporary welds.

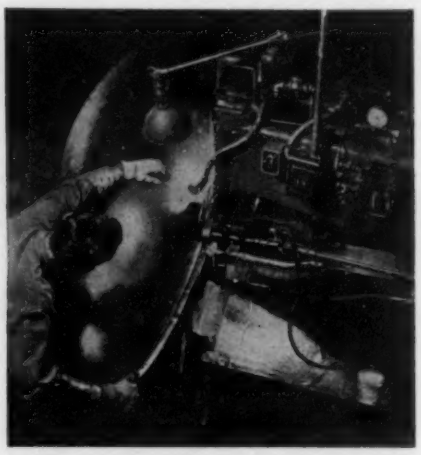
The use of electromagnets for this purpose is not new, but advantages claimed for the Sweetland Magnetic Clamp make it a highly practical application of the principle. The usual difficulties attendant upon lifting and transporting heavy magnets have been eliminated by compact, and relatively light-weight construction in comparison to holding power. The device is equipped with retractable ball-bearing wheels working on a ball-bearing swivel, making movement quick and easy.

With the Sweetland Magnetic Clamp, stiffeners are positioned and held in place while the tack welds are made directly, without the use of saddles, clips or other means requiring temporary welds. This cuts time by approximately two-thirds, does away with chipping, conserves materials otherwise needed for making saddles, yokes, etc., and avoids setting up stresses from temporary welds.

For fairing deck plates, one magnet is placed across the seam to bring plates to the same level. With warped plates, a single magnet used in conjunction with a Johnson bar quickly effects leveling.

DROPPABLE AIRPLANE GASOLINE TANKS "STITCHED"

At the Lockheed plant near Los Angeles, droppable gasoline tanks for the Lightning P-38 are now being seam welded by electronically controlled resistance welders, such as the one shown here, permitting the substitution of steel for war-scarce aluminum formerly used in these tanks. Equipped with precise General Electric electronic control which insures tough vibration-proof and gas-tight seams, this machine "stitches" two halves of the tank together at the rate of 60 in. per minute, taking only 4 min. for the complete tank.



Since no additional metal is deposited in this process, welding rod formerly used in torch welding is also saved.

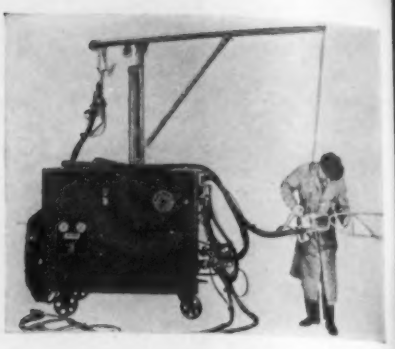
In use, two of the streamlined tanks are attached, like pontoons, to the Lightning P-38 and, when empty, may be dropped off to give the plane additional speed.

REPAIR CART SPOT-WELDS AIRCRAFT IN THE FIELD

An ingenious self-contained field-repair cart for repair spot welding of steel parts of an airplane on the spot, has recently been developed by Progressive Welder Company, Detroit 12. A considerable number of these units have already been produced and are in service.

Equipped with an electronic timer and a wide selection of both air-operated and manual "tong" type guns, the repair cart is capable of doing just about any kind of a spot-welding job on stainless and other light gage steels.

Regrigeration of transformers, cables and guns eliminates the need for external

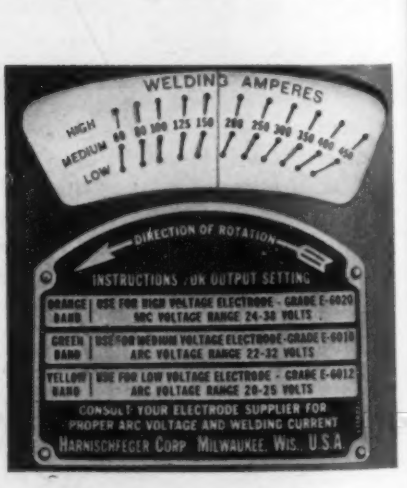


water connections, the condenser in the "Frostrode" refrigerating unit being air cooled. The refrigerant in turn circulates a low-temperature coolant through transformer, cables and guns.

Thus the only connection necessary to the repair cart is a power lead. Since the cart is provided with long cables, the connection can be made in a hangar or elsewhere and the cart rolled right out onto the landing field, if necessary.

NEW CALIBRATION PLATE

With its design taking into account the 3 electrode groupings according to low-, medium- and high-voltage requirements, a new d.-c. welder calibration plate claimed to give exactly the right heat across the arc for each electrode was recently announced by Harnischfeger Corp. Named the "Visi-Matic," P&H officials said it provides for all variables of amperage and voltage coincident to using today's wide range of coated electrodes, and, by its single current control, reduces proper selection of welding current to the simplest form. Calibrated in amperes, the new plate can be used with any make of


WELDING AMPERES
HIGH
MEDIUM
LOW
60 80 100 125 150
200 250 300 350 400 450
DIRECTION OF ROTATION
INSTRUCTIONS FOR OUTPUT SETTING
ORANGE BAND
USE FOR HIGH VOLTAGE ELECTRODE - GRADE E-6020
ARC VOLTAGE RANGE 24-38 VOLTS
GREEN BAND
USE FOR MEDIUM VOLTAGE ELECTRODE-GRADE E-6010
ARC VOLTAGE RANGE 22-32 VOLTS
YELLOW BAND
USE FOR LOW VOLTAGE ELECTRODE - GRADE E-6012
ARC VOLTAGE RANGE 20-25 VOLTS
CONSULT YOUR ELECTRODE SUPPLIER FOR
PROPER ARC VOLTAGE AND WELDING CURRENT
HARNISCHFEGER CORP MILWAUKEE, WIS., U.S.A.

electrode. Compensation for variations in voltage with the amount of current or amperes, as required by variations in electrode coatings, is attained by merely turning the one current indicator to the amperage setting desired in either the low-, medium- or high-voltage band. Individual color bands are used to designate the voltage ranges.

In addition to its straight production processes, the plant carries on considerable research and experimentation in improved machining and welding techniques, and [illegible] processes are proved, they are incorporated in production lines. One of these innovations is the employment of refrigerated points on spot-welding machines, enabling a 100 per cent increase in production, even with comparatively unskilled girl operators.

MACHINE TOOL BLUE BOOK June, 1943

at Willow Run

100% INCREASE IN PRODUCTION WITH

Refrigerated Electrodes

FROM aircraft plant after aircraft plant come reports almost too good to believe of weld-production increases traceable to refrigeration of welding electrodes.

FROSTRODE* is proud to be pioneering this striking development which has virtually eliminated pickup and reduced tip deformation to a minimum.

And now the availability of FROSTPOINT* electrodes with quick replaceable FROSTCAP* electrode tips have once more multiplied the effectiveness of refrigerated welding over even that attained with FROSTRODE* refrigeration units alone.

"FROSTRODE" refrigerating units are built by welding engineers for the welding industry. A model for every need.*

Replacing a "FROSTCAP" is as simple as this. Eliminates dressing of points.*

If you don't already know about this war vital development write or wire today for the following:

FROSTRODE System, Bulletin #F-43
FROSTPOINTS, Bulletin #P-43

**Components of the Frostrode Process (Pats. Pending)*

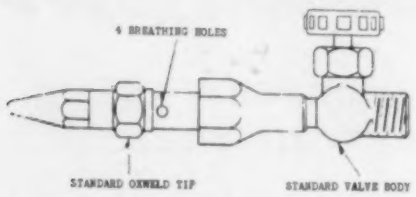
FROSTRODE PRODUCTS

Coolant Coolers • *Originators of* **Refrigerated Welding** • Low Temperature Cabinets

19003 JOHN R. ST. . . . DETROIT 3, U. S. A.

SPECIAL WELDING HEAD FOR LOW HEAT SOLDERING OPERATIONS

The accompanying sketch shows the construction of a special welding head when used with hydrogen for soldering operations. Acetylene can be used for a hotter flame by increasing the length of the injector head and decreasing the diameter of the hole in the injector head. This special head was developed for use in

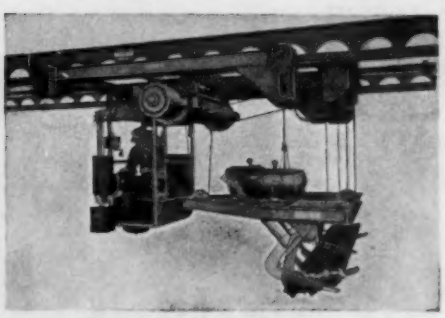


the East Pittsburgh Works of Westinghouse. When used with hydrogen, this tip gives a flame temperature of approximately 2000° F. When acetylene is used, the flame temperature is approximately 3500° F. Thus the head can be used for soldering operations requiring the use of lower melting solders and permits the use of a gas flame on materials that would be injured by the 6300° F. flame temperature of an oxyacetylene flame.

PIPE AND ROD CARRIER

A new welded motor-driven pipe and rod carrier developed by the Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio, permits the cab operator to pick up 1500 lb. of stock in 12-ft. lengths from the storage room, transport and set it in racks at fabricating machines, without any floor men.

Since the unit travels overhead its use eliminates the need of aisles and makes possible the saving of considerable floor area. In fact, the unit illustrated so reduced the need of floor space in an important war plant that 400 metal working machines could be installed and operated efficiently in a space slightly larger than that ordinarily required for 200 machines.



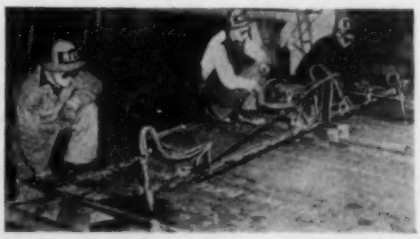
Obviously, this in turn brought about a tremendous saving in building construction materials, so vital at this time, as well as a great saving in capital investment. This one unit keeps all of these fast-working machines supplied with stock.

An outstanding feature of this equipment is the safety with which loads can be swiftly moved above machines and men. Materials transported need not be in balance nor is it necessary for the operator to spend time in locating the center of gravity of the load. The pick-up fork assembly has a 3-point rope suspension from the carrier which gives it the necessary rigidity for handling loads that are far out of balance. Another factor in providing stability is the double over-head track system on which the carrier travels. This minimizes swing and aids in removing the danger of loads slipping and falling in transit.

CANTILEVER BAR INCREASES RADIAGRAPH OUTPUT

A shop-built device for multiplying the productive output of a portable Radiagraph cutting machine has been put to use in a New England shipyard, accomplishing in a single stroke the work normally produced by two or more machines. As shown in the photo this attachment consists of a 10-ft. bar balanced crosswise on an Airco No. 4 Radiagraph, with the ends supported cantilever fashion by turnbuckled rods welded at the apex to a plate section. This bar carries four torches in adjustable positions for trimming parallel edges simultaneously on two plates, one on each side of the machine tracks.

Not only is linear cutting quadrupled by this device, but plate edges are cut accurately parallel. The secondary benefit obtained from this is, of course, a more precise fitup in assembly, with consequent speedup of welding butt joints. Three operators are required to maintain torch adjustment, but on regular production work the machine has produced 1240 linear ft. of cutting in 8 hr. The average for a single Radiagraph at these yards is 300 ft. per 8-hr. shift.



Courtesy Air Reduction Sales Co.

Multitorch Contrivance for Plate Squaring, Powered by a Standard Portable Radiagraph Cutting Machine

The 40-ft. track is laid in the trough of several sections of structural channel welded end to end, providing protection while plate is being laid out. Cumbersome lengths of gas hose are eliminated by the use of gas pipes mounted parallel to the torch bar. Four round mounting pads are welded at intervals on each side of the bar so that the torches can be fixed in any position along the bar, making fine adjustments by the rack and handscrew supporting each torch.

. . . with **X-RAY**

the modern way to check hidden structural members

X-ray lets you look through brick, wood, and concrete to locate and check piping and building structural members for condition—faults—obstructions—before opening up walls, floors and ceilings at great cost of time, men and money. This is just another of hundreds of unusual tasks that can be done better and faster with Westinghouse X-ray—the versatile production tool. J-02014

More dope? *See page 655*

Westinghouse
X-RAY
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

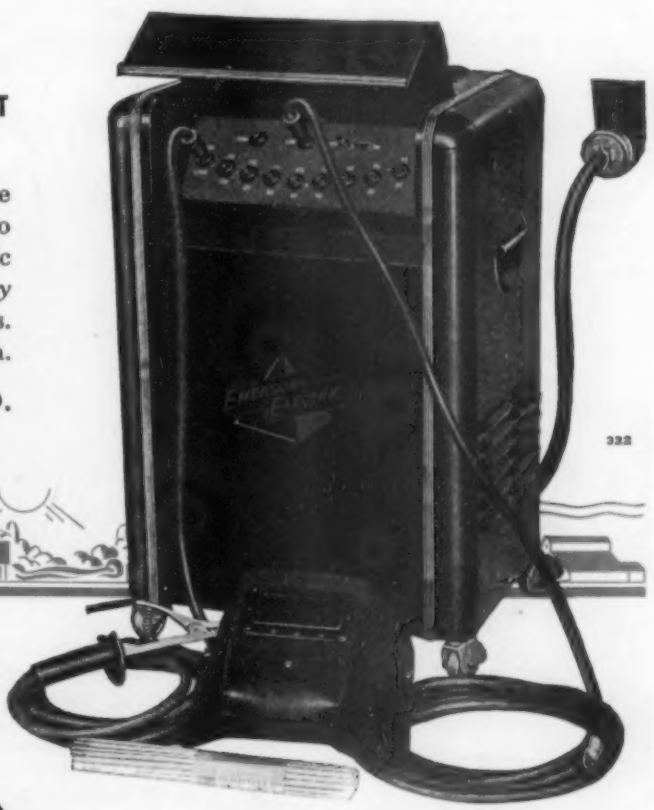
A medal for Arc Welding?

Not likely . . . yet if production processes, vital to the prosecution of the war, were to be singled out for recognition, Arc Welding would be at the head of the list. Its accomplishments have been outstanding. From the accelerated experience of today's conditions will come a new horizon for welding in a world at peace. Its contribution to better living will be universal.

EMERSON-ELECTRIC A. C. ARC WELDERS
SPEED UP PRODUCTION—CUT WELDING COST
Portable—Four Sizes—Six Types

In hundreds of war plants, Emerson-Electric Portable A. C. Arc Welders are on the job. . . . Each is built to the high quality standards typical of Emerson-Electric products for the past 53 years. *Available on priority ratings.* Approved by Underwriters' Laboratories. Write for prices, specifications, and performance data.

THE EMERSON ELECTRIC MFG. CO.
ST. LOUIS—*Branches:* New York • Chicago • Detroit
Los Angeles • Davenport

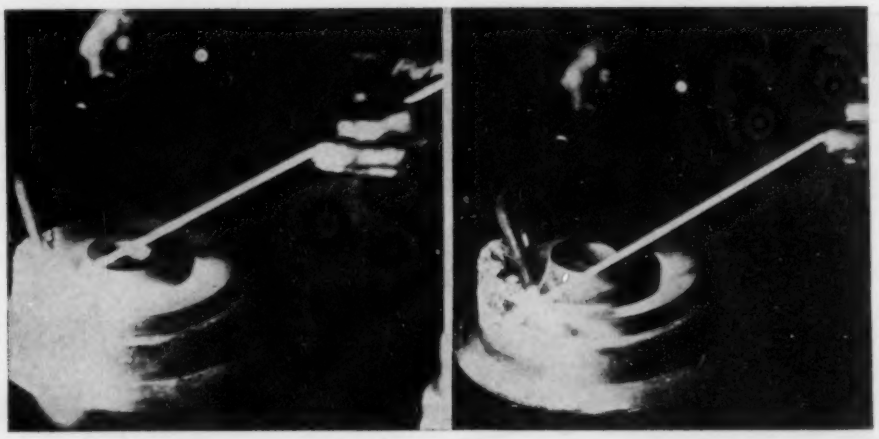


322

Emerson-Electric is now engaged 100% in the production of equipment for War or War Plant Use. In addition to regular products are Power-Operated Airplane Gun Turrets, Shell Parts and Electric Motors for Aircraft.

EMERSON ELECTRIC

MOTORS • FANS • APPLIANCES • A. C. ARC WELDERS

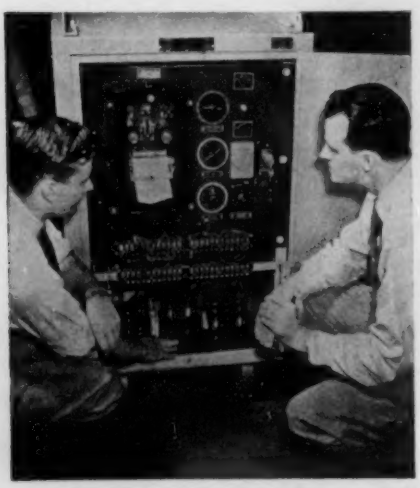


WELDING GLASS SPEEDS UP GAS WELDING

These unretouched photographs compare the efficiency of a standard welding lens and a new one developed by American Optical Co. scientists. Photograph at left was taken through the standard lens. Note how the "sodium flare" obscures the rod and bead. Picture at right reveals that welding goggles fitted with the new Noviweld-Didymium lenses enable a flame welder to look through the cloudy yellow flame of burning sodium vapors and see the rod and molten area more clearly. This clearer vision greatly increases the welder's efficiency, allows him to do more and better work and gives him greater protection and comfort.

AUTOMATIC VOLTAGE COMPENSATOR

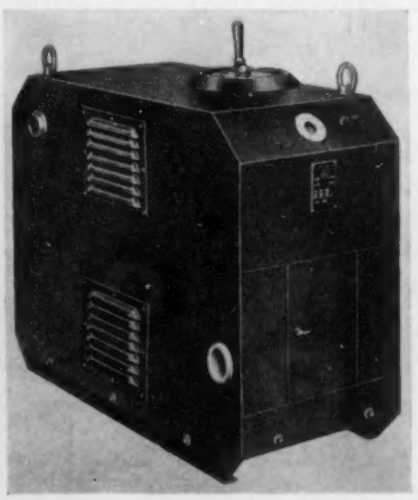
Robert S. Phair (left) and Edwin M. Callender, co-inventors of a new automatic voltage compensator for resistance-welding control, inspect the installation of their device in a resistance-welding control panel. Mr. Phair is assistant chief electrical and welding engineer and Mr. Callender, electronic research engineer, with the Edward G. Budd Manufacturing Company in Philadelphia. Their new compensator is shown installed in the bottom of the cabinet.



ALTERNATING-CURRENT WELDER

A new model, the G-R 49 heavy-duty manually operated transformer-type alternating-current welder, is announced by Glenn-Roberts Co. of Oakland, Calif. and Indinapolis. G-R 49 is definitely a "war baby" in that the machine has been engineered especially for the gruelling service demanded by 24-hr.-day, 7-day-week schedules of war production plants.

G-R Model 49 is designed and constructed with a large extra margin of safety to handle continuous welding loads, incorporating for this purpose an oversized core working at low flux densities. Two open-circuit voltages give a very wide variety of applications, particularly for the welding of heavy plate, within the machine's output range of 100–675 amps.



Contactor with push button control for the power is provided. When desired, the G-R Model 49 can be adapted from hand to automatic operation. Rod from 1/8- to 3/8-in. diameter is handled, with the only required adjustment being a twist of the hand wheel.

SAFETY GOGGLE

A new welder's safety goggle—the only design now authorized by WPB to use high-priority Plexiglas for lenses, is convertible from welding to general utility goggle in an instant by snapping out glare filter. Lens material is crystal clear; non-distorting; will not shatter or splinter under impact; and resists pitting caused by hot sparks. Goggle fits directly over prescription glasses, and full frame gives added protection against injury from sides, top and bottom.

Lenses can be easily removed for cleaning or replacement. All-plastic frame is strongly reinforced with metal spring clip at bridge, and is amply ventilated to reduce perspiration and prevent fogging. Exceptionally light, weighs only 1 3/4 oz., an important factor with women.

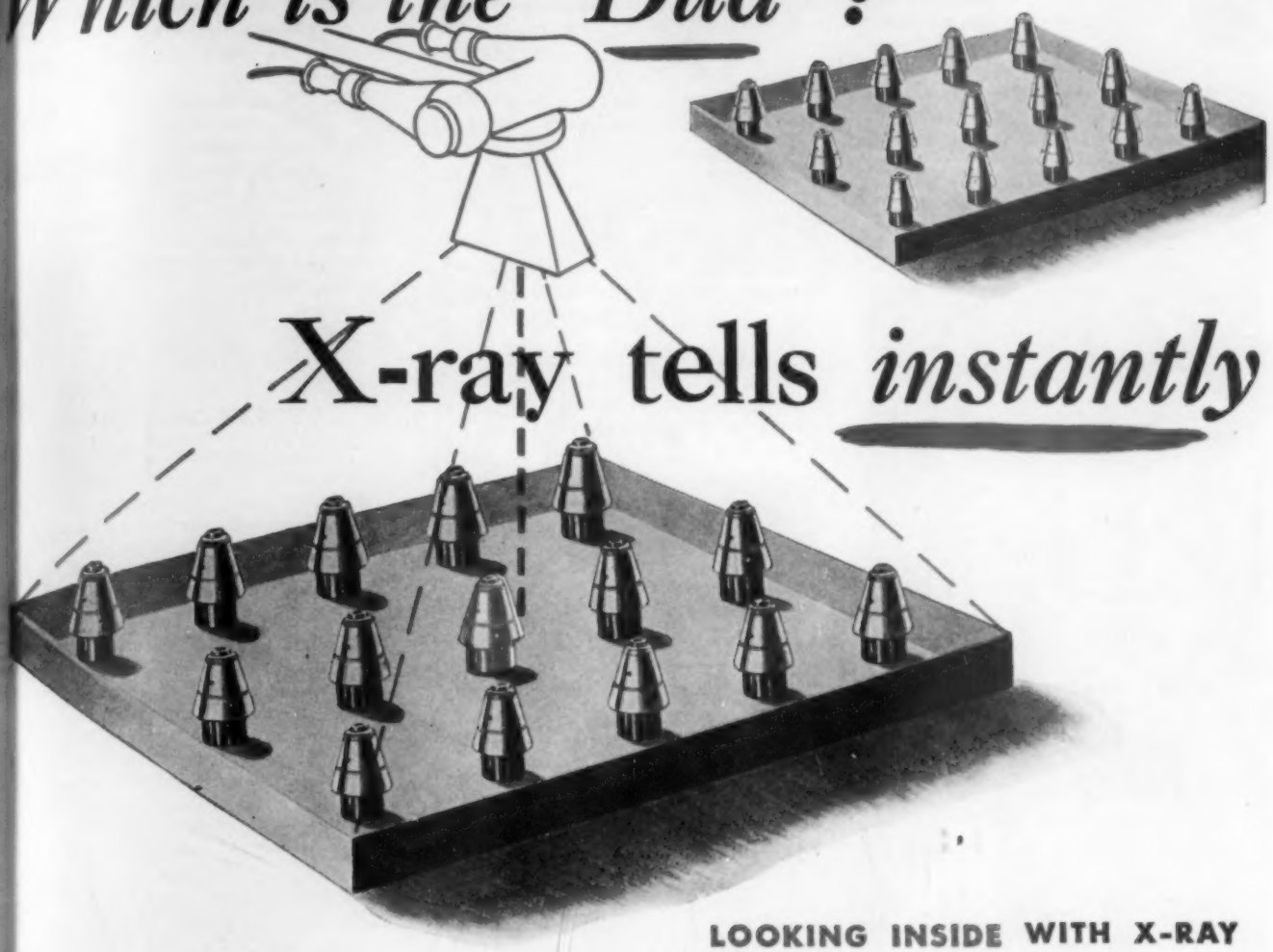
"Eye Savers" are available through your own jobber, or write direct to Watchemoket Optical Co., Providence, R. I.

CHIPPING HAMMER

The Universal Tomahawk, an improved chipping hammer with the exclusive feature of interchangeable and replaceable cone, and chisel bits and handle, for all types of weld cleaning, has been added to the line of welders' tools being manufactured by Atlas Welding Accessories Co., Boulevard Bldg., Detroit, Mich.

The tool comes in two 10-in. models: standard with weight of 11 oz., and heavy duty with weight of 15 oz. Snug socket-fit of bit shank, positioned and held by set screw, prevents possibility of loosening.

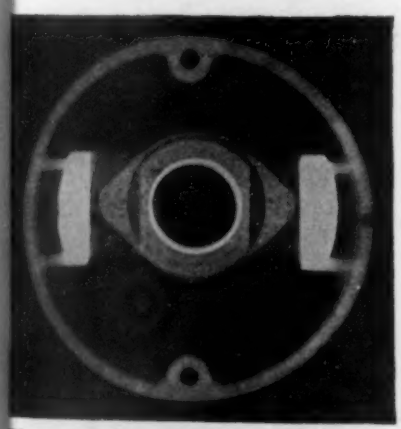
Which is the "Dud"?



X-ray tells *instantly*

LOOKING INSIDE WITH X-RAY

ASSURES 100% PERFECT DIE CASTINGS



X-ray reveals porosity in die casting—a typical example of how x-ray inspection helps control quality by detecting subsurface faults.

Critical jobs like bomb and shell fuses needed in huge volumes are a "natural" for the die casting process. It provides advantages held at high premium for war production: (1) high-speed, precision production (2) little or no finishing (3) conservation of critical materials.

Each part, however, must be perfect. Faults undetectable by ordinary inspection may cause premature explosions or other ammunition failures. But with x-ray on the job—faulty castings are detected easily—nondestructively—and without penalizing the high production speeds possible with die casting.

Quality control of die castings is only one of hundreds of production jobs that can be done faster, better and cheaper with x-ray. Others include inspection of welds, packages, assemblies, and countless other jobs.

Learn more about x-ray. Write for our new 38-page book on x-ray inspection . . . it explains x-ray . . . how to set up an x-ray department . . . how to select the right equipment. Ask for B-3159.

Or to discuss your problem with an Industrial X-ray Specialist, call your nearest Westinghouse office. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

J-02020

LOOK INSIDE WITH WESTINGHOUSE X-RAY

Westinghouse

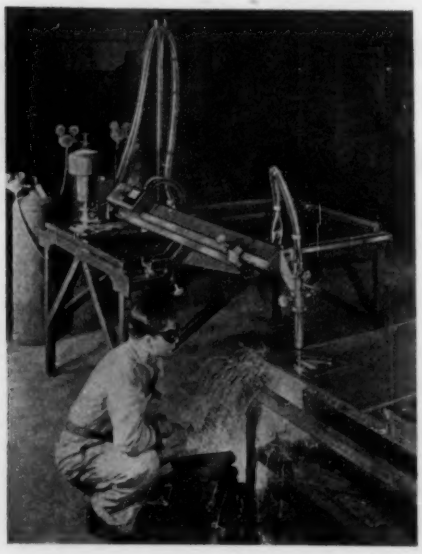
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

X-RAY

CUTTING MACHINE

Accuracy in cutting, compactness of size, ease of control and economy of operation are built into the new JR. It is designed to handle all cutting jobs from the smallest up to an overall size of 3′ x 4′.

An important fact which accounts for the accuracy-of-cut obtained with the new JR is that a number of the proved operating and construction features of this machine have been adapted from National's large type "R."



Each one of the JR features indicates conclusive research and thorough first-hand knowledge of the operating conditions and problems encountered in the field. National Cylinder Gas Company, 205 West Wacker Drive, Chicago.

WELDED TANKS IN INDIA

Tanks of any description are doubtless a challenge to the simple philosophy of the dark-skinned natives of India. But the wonder is made even more spectacular when these stern warriors learn that the thick armor plate around these massive fighting machines is welded together to make a solid, seamless protection against the enemy's fire power.

To India's fighting men, war is a stern business. But they also know that modern arc welding has made resistance stronger by making their tanks more rigid, tougher and safer.

Office of War Information Photo. Courtesy The Lincoln Electric Co., Cleveland, Ohio

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"LADY FROM MARS" SEWS STEEL WITH ELECTRIC ARC

A girl welder at the East Pittsburgh works of the Westinghouse Electric & Mfg. Co. is shown above selecting a welding rod for the job at hand, a frame for a big elec-

Welding Frame of Electric Motor

tric motor. Her Martian-like outfit is the latest thing for lady welders—safety glasses to guard her eyes; a flame-resistant canvas kept to keep sparks off her hair and the back of her neck; leather gloves, sleeves, apron and spats that repel hot metal; and steel-toed safety shoes.

NEW WELDING SHIELD

Davis Emergency Equipment Corp., 55 Halleck St., Newark, N. J., announces that they have ready for immediate delivery a large quantity of new models of Huntsman acetylene and arc-welding shields.

These new shields embody a number of valuable, exclusive features. Designed by a welder for extra comfort and complete protection, the Huntsman shield has a patented locking device and an extremely comfortable, easily adjustable headgear. The locking device holds the shields in the correct position before the face to assure that the line of vision passes through the lens at right angles to the surface of the glass. It also holds the shield firmly above the head while the welder is preparing, chipping or surveying his work. When welding must be resumed, a slight nod of the head will lower the shield into the correct working position. The locking device automatically adjusts the shield to the same position each time.

Huntsman shields are light in weight ranging from 1 to 1½ lb. and are available for immediate delivery from stock in six models. An interesting, colorful folder describing these models is available. Companies who have had difficulty in getting welding shields in necessary quantities can be sure of quick delivery of the models selected.

WELDER'S CHECK CHARTS

The three essentials of proper welding procedure—(1) correct electrode, (2) correct travel speed, (3) correct welding current—are graphically illustrated and discussed in the two welding check charts being announced by The Hobart Brothers Company, Troy, Ohio, manufacturers of arc welders, electrodes and accessories.

One chart shows illustrations and characteristics of weld deposits from electrodes under various conditions: welding current too low; welding current too high; arc too long (voltage too high); welding speed too fast; welding speed too slow; and a weld showing the results obtained when the proper current and speed of welding are just right. Other illustrations show speed in feet per hour that can be obtained in a good weld using specific sizes of electrodes, how to cut rod waste, and care of your present welding equipment.

The other chart lists 19 Hobart electrodes and describes the use and purpose of each grade of electrode for the particular welding job at hand. The back of each chart gives the Alloy Metals Finding List of Hobart's Special Metals Data Service and list of sources.

The two wall charts, each 18 x 33 in. printed in two colors on heavy paper, will be sent free to those interested in Proper Welding Procedure. Write The Hobart Brothers Company, Troy, Ohio, enclosing 10¢ in stamps to cover cost of mailing only.

WELDING has changed the complexion of oil storage tanks

In the early days of the oil industry steel tanks were riveted and it was often difficult to keep the joints tight. It was not uncommon to see dark streaks on crude oil tank shells due to leaks in the joints. Welding has stopped all that. Nowadays those tell-tale streaks are disappearing as welded joints seldom leak. Their higher joint efficiencies also make possible the more economical use of steel plates

CHICAGO BRIDGE & IRON COMPANY

Chicago.....2455 McCormick Bldg.	Birmingham.....1507 North 50th Street	Washington.....330 Bowen Bldg.
New York.....3390—165 Broadway Bldg.	Tulsa.....1654 Hunt Bldg.	Philadelphia.....1668-1700 Walnut Street
Cleveland.....2282 Guildhall Bldg.	Houston.....5621 Clinton Drive	San Francisco.....1097 Rialto Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM and GREENVILLE, PA.

SECTION ACTIVITIES

CHATTANOOGA

The Chattanooga Section has elected the following men as officers for the calendar year 1943–44: *Chairman*, P. O. Leach; *Vice-Chairman*, Justin W. Brown; *Secretary-Treasurer*, R. G. Wilson.

DETROIT

The Executive Committee of the Detroit Section held its organization meeting for the 1943–44 season on Friday evening, June 11th.

During the coming year the meetings of this Section will be held on the first Friday of each month in the Horace H. Rackham Educational Memorial Building, with the exception of May when it is planned to hold a Welding Conference at one of the hotels.

ST. LOUIS

The following are the newly elected officers for 1943–44: *Chairman*, E. F. Meier, Monsanto Chemical Co.; *Vice-Chairman*, W. S. Evans, Curtiss-Wright Corp.; *Secretary*, H. C. Close, Machinery and Welder Corp.; *Treasurer*, Geo. O. Bland, Hill Eqpt. Engrg. Co. *Directors:* C. H. Armstrong, R. L. Christie, A. W. Harris, B. H. Leonard, R. J. Sacks, Arthur S. Schwarz. *Program Committee Chairman*, I. T. Olson, The Linde Air Products Co.; *Membership Committee Chairman*, R. L. Christie, Aluminum Ore Co.

SAN FRANCISCO

The June meeting was held on the 25th at The Engineers' Club of San Francisco and was preceded by a dinner. The discussion at this meeting was devoted entirely to matters requested by various members on problems which they have encountered. The subjects discussed were: the different machine settings for various types of electrodes; the relative stresses set up by welding as compared to flanging; the relative stresses set up by scarfing as compared to chipping; the cracking of welds in refrigerator ships when first cooled. The discussion was followed by the new General Electric Technicolor Sound Motion Picture entitled "Atomic Hydrogen Welding."

WESTERN MASSACHUSETTS

The May meeting of the Western Massachusetts Section held on May 31st in the Holyoke Y.M.C.A. was opened at 8 P.M. by the Chairman, Mr. Emery, who welcomed members and guests in attendance representing ten companies from the Section.

The technical speaker for the evening was Mr. E. C. Korten, Assistant Chief Engineer of the Boiler Division at the Hartford Steam Boiler Inspection and Insurance Company. Mr. Korten presented a paper on the "Qualification of Welding" illustrated by numerous instructive slides. Subjects covered were the standardization movement in the various welding code committees, the qualification of procedure and operations, the tests required, the approved record forms and the qualification of automatic and Unionmelt welding. At the conclusion of Mr. Korten's talk it was clearly evident that many questions existent in the minds of the members were answered and that Mr. Korten had done a fine job in clarifying the all-important subject of qualification.

The June meeting of the Section held on June 28th in the Holyoke Trade School was opened at 8 P.M. by the Chairman, Mr. Emery, who welcomed 61 members and guests representing 17 companies.

Mr. Charles Black, Sales Engineer with the Smith Welding Company, presented a talk on the "Conservation of Gas-Welding Equipment." Mr. Black enumerated several points about the proper use of welding and cutting torches and regulators, using actual equipment in his lecture. Mr. Black pointed out that the life of gas-welding equipment is greatly increased by proper care. Concluding his talk, Mr. Black emphasized that material for this equipment is subject to priorities, and for patriotic reasons the equipment should be conserved.

Mr. F. W. Edgerton, Welding Engineer with the Austin Hastings Company, presented an illustrated talk on "Tool and Die Reclaiming with Gas and Electric Welding." Subjects covered were, the types of electrodes, the preheat, the welding and post heat on several applications of hard facing, with pictures before and after welding.

Following Mr. Edgerton's talk, the group adjourned to the N.Y.A. School where facilities were available for actual demonstration by the two lecturers. Mr. Black demonstrated the correct use of gas-welding equipment and showed the group how to braze properly. Mr. Edgerton demonstrated some points on hard surfacing and presented several exhibits of expensive tools, dies and gears that were saved by this process. The interest shown by the group was spectacular in that the demonstration had to be cut short at midnight.

List of New Members

June 1 to June 30, 1943

BIRMINGHAM

Coupland, Frank H., Jr. (B), American Cast Iron Pipe Co., P. O. Box 2603, Birmingham, 2, Ala.
Vann, J. Thompson (B), American Cast Iron Pipe Co., P. O. Box 2603, Birmingham, 2, Ala.

BOSTON

Barron, William F. (C), Boston Navy Yard, Boston, Mass.
Bornheimer, James W. (C), Black Pt. Rd., Scarborough, Me.
Burton, Malcolm S. (C), Mass. Inst. of Tech., Room 35—165, Cambridge, Mass.
Paine, Charles H. (D), 38 Old Orchard St., Old Orchard, Me.
Pierson, Robert P., Lt. (jg) (C), Boston Navy Yard, Boston, Mass.

CANADA

Johnston, James S. (B), Dominion Oxygen Co., 3737 St. James St., W., Montreal, Canada.

CHATTANOOGA

Clark, Hurlbut G. (C), 935 Signal Rd., Signal Mt., Tenn.
Cowart, Virgil A., Lt., U.S.N. (C), U.S.S. *Ajax*, % Supvr. of Shipbldg., Los Angeles Shipbldg. & Dry Dock Co., San Pedro, Calif.

CHICAGO

Burrowes, Edward J. (C), 1338 S. 57th Ct., Cicero, Ill.
Callner, S. S. (C), Eutectic Welding Alloys Co., 53 W. Jackson Blvd., Chicago, Ill.
Davey, Carl (B), 822 Warren St., Miller Beach, Gary, Ind.
Harms, Harrison O. (C), 6530 Pershing Rd., Berwyn, Ill.
Hughes, Maxwell L. (C), 7724 Marquette Ave., Chicago, Ill.
Ludtke, Alfred (C), 14752 Perry Ave., Harvey, Ill.
Pierce, John M. (C), 8023 Evans Ave., Chicago, Ill.
Powell, George (D), 3005 N. 78th Ct., Elmwood Park, Ill.
Strachanowski, S. (D), 2161 N. Stave St., Chicago, Ill.
Williams, Frank K. (B), 1918 Colfax St., Evanston, Ill.
Wolf, George M. (C), Electro-Motive Div., 55th & Joliet Rd., La Grange, Ill.

for SUPERIOR HARDNESS and STRENGTH in Bronze Weld Metal, Use Wear-Resisting

AMPCO-TRODE

THE *Original* COATED ALUMINUM BRONZE WELDING ROD

Select from 7 Grades of Coated Aluminum Bronze Electrodes to Obtain the Weld Metal You Need . . .

With Brinell hardness from 100 to 350 and tensile strength up to 90,000 psi., Ampco-Trode coated bronze electrodes provide a wide range of physical properties. Thus you can select a grade that matches the base metal or that will be satisfactory for the special service required of the weld metal.

Ampco-Trode coated aluminum bronze welding rods are made from Ampco Metal, well-known in aircraft and industry for its high physical properties, excellent bearing characteristics, and inherent wear-resistance. This alloy is used extensively in War production plants and Ampco-Trode electrodes also are favored by many Government contractors. It is used for building up worn shafts, wear strips and valve seats; overlaying bearing surfaces; and refacing steel and cast iron for added wear-resistance.

Ampco-Trode coated bronze electrodes are suitable for a great variety of applications. Outstanding results will justify your choice. Try them in your plant. Ask for Ampco-Trode Bulletin.

CHOOSE FROM THESE 7 GRADES

Ampco-Trode 10 All-purpose coated aluminum bronze electrode—for arc-brazing manganese bronze, brass, steel, or malleable iron. Higher strength and greater hot ductility than any other bronze weldrod.

Ampco-Trode 12 A soft, tough bronze with good bearing properties — Ampco Metal Grade 12 — for bronze overlays running against soft steel.

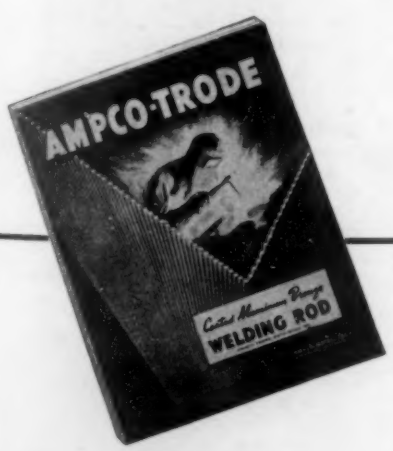
Ampco-Trode 16 A tough bronze of high tensile strength — Ampco Metal Grade 16—for bronze welds and overlays with good resistance to wear and impact.

Ampco-Trode 18 A strong bronze with good ductility—Ampco Metal Grade 18—unequalled for bronze overlays requiring the maximum bearing and wearing properties.

Ampco-Trode 20 A hard bronze—Ampco Metal Grade 20—for building up bearings working against hardened steel.

Ampco-Trode 21 A very hard bronze—Ampco Metal Grade 21—used for overlaying cast iron, steel or bronze for very hard bearings or on dies to reduce die wear and marking of the sheet metal.

Ampco-Trode 22 An extremely hard bronze—Ampco Metal Grade 22—for overlaying drawing dies to avoid draw lines on the sheet metal being formed.



AMPCO METAL, INC.

DEPARTMENT WJ-8

Milwaukee 4, Wisconsin

CINCINNATI

Miller, Paul E. (D), General Delivery, New Carlisle, Ohio.

CLEVELAND

Bolz, Norman H. (B), Paterson-Leitch Co., 900 E. 69th St., Cleveland, Ohio.
Conway, Bruce H. (C), 3966 W. 162nd, Cleveland, Ohio.
Reinke, Fred A. (B), 18316 Rosecliff Rd., Cleveland, Ohio.
Schulz, Earl (D), 5542 Adams Ave., Ashtabula, Ohio.
Stevens, George (D), 1874 Torbenson Dr., Cleveland, Ohio.
Wood, Kenneth (B), % The East Ohio Gas Co., Ft. of E. 62nd St., Cleveland, Ohio.

COLUMBUS

Griffith, Wm. H. (B), 1204 Lincoln Rd., Columbus, Ohio.

DETROIT

Bohnhoff, Steward K. (B), 9346 Cairney Ave., Detroit, Mich.
McIntyre, Walter J. (B), 1201 Niagara Ave., Flint, Mich.
Mills, Harold B. (C), 2423 Barth St., Flint, Mich.
Moore, Wm. A. (C), 15150 Dolphin, Detroit, Mich.
Shrider, Geo. W. (C), 13350 Leonard St., Dearborn, Mich.
Valade, Laurence E. (B), 6361 Fenton Rd., Flint, Mich.

INDIANA

Alberson, Clyde W. (D), 615 E. Gilbert St., Muncie, Ind.
Ranshaw, Wm. C. (D), 1822 Main St., Anderson, Ind.

LOS ANGELES

Barron, Norwood L. (C), Box 185, Hermosa Beach, Calif.
Burnett, A. D. (B), 461 W. 20th, Long Beach, 6, Calif.
Champane, F. A. (C), 5747 Taft Ave., Hollydale, Calif.
Cline, Lee S. (C), 4230 Mortimer Rd., Lynwood, Calif.
Gray, Albert (D), 648 E. 77th St., Los Angeles, Calif.
Hubbert, Robert L. (C), 308 E. Norwood Pl., Alhambra, Calif.
Lehman, Wendell F. (C), % Ryan Aeronautical Co., Lab., Lindberg Field, San Diego, Calif.
Malter, Frank J. (C), 606 S. Hill St., Los Angeles, Calif.
Tawney, Howard D. (B), 6330 A State St., Huntington Park, Calif.
Wise, Tommy (D), 3538½ Siskiyou St., Los Angeles, Calif.

MARYLAND

Clautice, Wm. E. (C), 1606 E. 28th St., Baltimore, Md.
Sanford, James P. (C), 2535 McHenry St., Baltimore, Md.

MILWAUKEE

Renquist, Gerald A. (C), 404 E. Juneau Ave., Milwaukee, Wis.
Wardecke, Oscar (C), 2452 N. 19th St., Milwaukee, Wis.
Wurth, Ray W. (C), Harris Calorific Sales Co., 2467 W. Fond du Lac Ave., Milwaukee, 6, Wis.

MOBILE

Buchanan, George G. (C), 252½ N. Claiborne St., Mobile, Ala.

NEW YORK

Borst, B. T. (C), 580—3rd Ave., Brooklyn, N. Y.
Corlito, Michael A. (C), 554—6th Ave., Brooklyn, N. Y.
Mazor, John (C), 8815—5th Ave., N. Bergen, N. J.
Moles, Edward W. (C), 130-42—231st St., Laurelton, Queens, N. Y.
Waldt, Carl (C), Edo Aircraft Corp., College Point, L. I., N. Y.
Warren, Grant (C), % The Sherburne Co., 67 W. 44th St., New York, N. Y.
Zeisel, Albert E. (C), Hotel Shelton, 49th St. & Lexington Ave., New York, N. Y.

NORTHERN NEW JERSEY

Dinnick, George M. (B), Westinghouse Electric & Mfg. Co., Bloomfield, N. J.
Gates, John R. (D), RCA Victor Div., Harrison, N. J.
Goodliffe, J. W., Jr. (C), Johnson Ave. & Grove St., Elizabeth, N. J.
McBride, George (A), Otis Elevator Co., 605—1st St., Harrison, N. J.
Smith, Irving K. (A), Croll-Reynolds Engrg. Co., 17 John St., New York, N. Y.
Stevenson, Geo. (C), 47 Squadron—14th Group, A.P.O. 622—U. S. Army Motor Shop, Miami, Fla.

NORTHERN NEW YORK

Jordan, Robert E. (D), 19 Beck St., Fort Plain, N. Y.
Thuener, Harold A. (D), R.F.D. 2, Ballston Lake, N. Y.

NORTHWEST

Freeman, Stefan F. (B), Brown Steel Tank Co., 2901—4th St., S. E., Minneapolis, Minn.
Solem, Hans H. (C), 3558 James Ave., N., Minneapolis, Minn.

OKLAHOMA CITY

Bowen, C. M. (C), Lincoln Electric Co., Box 5006, Oklahoma City, Okla.

PHILADELPHIA

Beittenmiller, J. Warren (C), 1028 S. Ithan St., Philadelphia, 43, Pa.
Claus, Arthur E. (C), Pennington, N. J.
Henry, Jackson B. (C), 301 Sycamore Ave., Folsom, Pa.
Maiwurm, Paul S. (B), R.D. 1, Pennsburg, Finland, Pa.
Pratt, Wilbur G. (B), P.O. Box 38, Thorndale, Pa.
Solway, J. E. (D), 1019 Monroe St., Wilmington, Dela.
Walker, Earl B. (C), Air Reduction Sales Co., 17th St. & Allegheny Ave., Philadelphia, Pa.

PITTSBURGH

Adams, Ludwig (B), Mellon Inst., 4400—5th Ave., Pittsburgh, Pa.
Cuntz, Wm. C. (B), Metal & Thermit Corp., 1514 North Ave., West N. S., Pittsburgh, Pa.
Knapp, E. J. (B), Metal & Thermit Corp., 1514 North Ave., West N. S., Pittsburgh, Pa.
Reaves, Ira J. (B), 5472 Hillcrest St., Pittsburgh, Pa.
Stuchell, Robert McClure (B), Mellon Inst., 4400—5th Ave., Pittsburgh, Pa.

PUGET SOUND

Myers, John L. (C), 44 Menlo Park, Tacoma, Wash.

ST. LOUIS

Armstrong, C. H. (C), 1905 Kienlen Ave., St. Louis, Mo.

SAN FRANCISCO

Barnard, Lester (C), 1821 San Pablo Ave., El Cerrito, Calif.
Jackson, Chandler C. (B), 450 S. 9th, Apt. 1C, Richmond, Calif.
Nance, Hollis E. (C), 120 Lincoln Highway, Vallejo, Calif.
Nobles, Acie E. (C), 205 Coral Rd., Apt. 428, Vallejo, Calif.
Parker, Woodrow (B), 524 S. 18th St., Richmond, Calif.
Phillips, David J. (C), 449 S. 17th St., Richmond, Calf.
Polivka, Jaro J. (B), Univ. of Calif., Engrg. Materials Lab., Berkeley, Calif.
Silow, Elmer (C), Rt. 1, Box 182A, Walnut Creek, Calif.
Smith, Orin (C), 2020 Hodgson, Eureka, Calif.
Thomas, Albert W. (C), 416 Cornell Ave., Albany, Calif.

TOLEDO

Bracken, Robert O., Lt. (jg) (C), Toledo Shipbldg. Co., Coast Guard Insp. Office, Toledo, Ohio.
Henshaw, Gaylord H. (C), 774 Orchard St., Toledo, Ohio.
Richardson, C. M. (C), Lincoln Elec. Co., 663 Spitzer Bldg., Toledo, Ohio.
Weinstein, Harold (B), 513 Potter St., Toledo, Ohio.

TULSA

Shreve, E. K. (D), 1712 W. Easton Ct., Tulsa, Okla.

WESTERN MASS.

Landry, Albert (C), 833 Columbia St., Chicopee Falls, Mass.
Manini, Andrew J. (D), 387 Walnut St., Springfield, Mass.
Pollard, Thomas T. (D), 556 Bridge St., Holyoke, Mass.
Potorski, Louis J. (C), 38 Jennings St., Chicopee Falls, Mass.
Roots, Calvin L. (C), 38 Berkshire Ave., Springfield, Mass.
Stray, M. I. (B), 15 Woods Ave., Holyoke, Mass.
Tiley, C. A. (B), Williamburg, Mass.
Valiquette, J. Henry (B), 24 Park St., Springfield, Mass.
Van Duyne, Fred C. (C), 30 Packard Ave., Somerville, Mass.

WESTERN NEW YORK

Doebert, Martin H. (D), Burgard Vocational High School, 400 Kensington Ave., Buffalo, N. Y.
Graham, John T. (C), 230 Le Roy Ave., Buffalo, N. Y.
Gruenberg, John W. (C), 16 W. 2nd St., Dunkirk, N. Y.
Rivenburgh, M. R. (C), 143 Highland Rd., Williamsville, N. Y.

YORK—CENTRAL PENNA.

Brady, E. J. (A), Alloy Rods Co., 501 E. Prospect St., York, Pa.
Conner, Walter R. (D), 175 W. 4th St., Lewistown, Pa.

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That is why we go to unprecedented lengths to assure *uniformity* in SMITHway Certified Welding Electrodes — not only as to concentricity, but also as to metallurgical characteristics of the wire and chemical analysis of its coating.

We know from our own shop experience that it pays us to put this extra effort into producing *better electrodes*.

We think we can *prove* that SMITHway Certified Welding Electrodes mean *more good welds* per man-hour at considerably *lower cost* in your plant, too.

Mild Steel . . . High Tensile . . . and Stainless Steel
WELDING ELECTRODES
made by welders . . . for welders

SMITHway Welding Monitor: *cuts time cost of training welders as much as 33⅓% by automatically signaling operator when correct feeding speed is or is not being maintained.*

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NOT IN SECTIONS

Alfaro, Antonio J. (C), Apartado 1211, Panama, R. P.
Baird, Gordon H. (D), 526 S. East St., Grand Prairie, Tex.
Collier, Michael O. (C), American Bank Bldg., Room 422, Miami, Fla.
Davis, Murray (C), R. R. 4, Box 4, Louisville, Ky.
Fitzgerald, George (D), C. H. Lein Constr. Co., Box 1807, Rapid City, S. D.
Galen, Clarence W. (C), 652 Council Crest, R.F.D. 2, Battle Creek, Mich.
Jameson, W. A. (D), 834 Georgia St., Amarillo, Tex.
Walker, Wm. A. (D), 439 E. Brandeis, Louisville, Ky.
Wilkinson, Keith C. (C), % Hume Steel Ltd., Upham St., Subiaco, W. Australia,

Members Reclassified

During Month of June

CHICAGO

Schumacher, George F. (from D to C), 403 Jewitt St., Elgin, Ill.

CINCINNATI

Gilreath, Rowan (from C to B), 3633 Ault Park Rd., Cincinnati, Ohio.

COLORADO

Rosenbach, A. J. (from D to C), 3527 Delgany, Denver, Colo.

COLUMBUS

Alff, Carl J. (from D to C), 340 Wilson Ave., Columbus, Ohio.

NORTHERN NEW YORK

Doty, W. D'Orville (from F to C), Rensselaer Polytechnic Inst., Ricketts Lab., Troy, N. Y.

SAN FRANCISCO

Klistoff, Al. (from D to C), 1464 Rhode Island St., San Francisco, Calif.

TOLEDO

Forman, Milton (from C to B), Toledo Shipbldg. Co., Toledo, Ohio.

NOT IN SECTION

Berg, Henry L. (from D to C), 801 S. Main, Three Rivers, Mich.

METAL INDUSTRY WILL MEET IN CHICAGO

Plans Announced for National Metal Congress

Plans for the 25th annual National Metal Congress in Chicago the week of October 18th, were announced today by W. H. Eisenman, managing director of the meeting and national secretary of the American Society for Metals.

"The entire Metal Congress and Conference Displays will be tuned to the increase of war production in the metal industry, to the conservation of metals and to postwar planning," Mr. Eisenman said. "All technical sessions and special daily War Production and Conservation sessions will be streamlined and comprehensive in their contributions to the war problems and will contribute decisively and materially to the shortening of the war.

"During the past year," Mr. Eisenman continued, "the metal industry has largely finished its plant expansion job for war and today it is confronted with production problems involving shortages of many strategic metals, more efficient use of equipment, and continued training of personnel. All of these problems will be dealt with at sessions of the Congress.

"Then, too, many companies have completed their war contracts or are forced by changes in war planning to go into new markets or obtain new contracts, and the War Conference Displays will meet these problems. New business, new ideas and developments will be brought together by manufacturers participating in the Conference Displays and thus aid in increasing the production of war products.

"Designed to meet wartime travel and transportation conditions," Mr. Eisenman concluded, "this year's meeting will help work out the problems of the metal industry with immense savings of time and travel, and will materially assist in maintaining war production at high levels."

Four big national societies will again cooperate in the forthcoming Metal Congress. In addition to the American Society for Metals, there will be the AMERICAN WELDING SOCIETY, the Wire Association and the Iron and Steel and Metals divisions of the American Institute of Mining and Metallurgical Engineers.

War Conference Displays and the sessions of the American Society for Metals will be concentrated in the Palmer House, with the AMERICAN WELDING SOCIETY at the Morrison Hotel, the Wire Association at the LaSalle, and the A.I.M.E. at the Sherman.

The Conference Displays will be located in the special rooms designed for light displays in the Palmer House. For different from anything in the past, these rooms will accommodate light equipment and metal parts. Manufacturers are being urged to use models, moving pictures, photographs and literature to present new developments to the industry.

However, there will be no changes in basic facilities that will enable engineers, executives and production men to get together in one convenient and coordinated meeting-place to help solve mutual problems and to bring to the attention of all the developments of the year in the metal industry.

BETTER HOUSES IN POSTWAR ERA*

Greatly improved houses will be built in the postwar period, but they will result from evolutionary progress, not miracles. This is the view of Kenneth K. Stowell, editor of *Architectural Record*. In an editorial in the July issue of the magazine he says, "The house of the future will perform the same functions as the house of the past and the house of the present. The functions of this house will be to provide shelter, privacy, comfort and convenience."

With regard to the house itself, Mr. Stowell states that it will have rooms thoughtfully planned for maximum use of the space enclosed. It will have foundations, floors, walls, ceiling, partitions, roofs and openings; windowpanes will be of transparent materials. Installed equipment will provide for heating, air conditioning, sanitation; pipes will deliver water and remove waste. There will be automatically operated refrigerators and food preparation will be facilitated by many electrical devices. There will be a garage for the family automobile, perhaps in time a garage for the family helicopter. In short, as to general functions and characteristics, the house of the future will be very similar to the familiar house of today.

Respecting new production methods and uses of new materials, the statement continues: "The house of the future will probably be put together more rapidly than the house of the past, thanks to the evolving techniques of the building industry. Materials and equipment that can be produced in the factory in easily handled sub-assemblies will be available to be incorporated in the building at the site. The designers of houses will continue to produce more livable and efficient environments as knowledge of space relations grows and the performance of materials and equipment proves their relative desirability. Designers will make intelligent selection from the many diverse materials (new and old) that will be offered in a competitive market. The house of the future will still be a house. It will still be subject to the whims of the public, to the development of manufacturing procedure in a competitive market, and to the intelligence and daring of the designers."

*Reference is made to Mr. Stowell's editorial, as the Editor of THE WELDING JOURNAL believes that welding will play its part in these developments.

TENTATIVE PROGRAM

TWENTY-FOURTH ANNUAL MEETING
AMERICAN WELDING SOCIETY
WEEK OF OCTOBER 18, 1943

HOTEL MORRISON, CHICAGO, ILLINOIS

Make Room Reservations Early—Direct with Hotel Morrison

Arrive Sunday 17th—(Convention Hotel) Rates Apply for Short or Long Stay

IMPORTANT

ALL Technical Sessions will positively start on time.

No Stenotype Reporter—Members desiring to discuss papers are urgently requested to prepare discussion in writing in advance of the meeting and to send copies to headquarters as those preparing written discussion will be given preference at the sessions. Members and guests giving extemporaneous discussion at meeting should forward a written transcript of discussion as soon as possible after the meeting.

Members and guests are urged to REGISTER immediately upon arrival at A.W.S. HEADQUARTERS and obtain Convention Badge admitting them to Exposition.

NO REGISTRATION FEE but a charge of $1.00 (per member) and $1.50 (non-member) is made for Technical Sessions Papers.

Registration hours throughout the week:

Hotel Morrison

Monday, Tuesday and Wednesday 9 A.M. to 5 P.M.
Thursday 9 A.M. to 12 Noon

MONDAY, OCTOBER 18th, Morning—9:30 A.M.

OPENING SESSION

Chairman—K. L. HANSEN,
President, American Welding Society

Vice-Chairman—E. V. DAVID,
Chairman, Convention Committee

PRESENTATION OF MEDALS AND PRIZES

The Adams Lecture, by Dr. C. A. ADAMS, First President, American Welding Society

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Monday Afternoon—2:00 P.M.

SIMULTANEOUS TECHNICAL SESSIONS

CUTTING

Chairman—ELLSWORTH L. MILLS,
Bastian-Blessing Co.
Vice-Chairman—H. E. ROCKEFELLER,
The Linde Air Products Co.

Flame Cutting Heavy Sections and Large Diameters
by R. L. DEILY and E. BENYO, Bethlehem Steel Company

Welding and Cutting in Steel Mills
by T. W. MORGAN, American Rolling Mill Co.

Electronic Control of Gas-Cutting Machines
by R. D. McCOMB, General Electric Co.

Machine Cutting for Assembly Line Fabrication
by CHARLES O. ADAMS, Delco Products

RAILROAD

Chairman—A. G. OEHLER,
Editor, Railway Age
Vice-Chairman—C. E. MORGAN,
Chicago, Milwaukee & St. Paul R. R.

The Welded Locomotive Boiler
by E. G. YOUNG, University of Illinois

Welding as It Applies to Railroads
by ROBERT MORAN, Missouri Pacific R.R.

Railroad Shop Welding and Cutting
by J. W. KENEFIC, Air Reduction Sales Co.

Welding of Railroad Transport Equipment
by C. DREUTZLER, Electro-Motive Corp.

WELDABILITY

Chairman—A. B. KINZEL,
Union Carbide & Carbon Res. Labs.
Vice-Chairman—C. H. JENNINGS,
Westinghouse Elec. & Mfg. Co.

Investigations at Lehigh
by GILBERT E. DOAN, Lehigh University

Investigations at Rensselaer Polytechnic Institute
by WENDELL F. HESS, R. P. I.

The Weldability of Silicon Steels
by C. E. JACKSON and G. G. LUTHER, Naval Res. Lab.

Weld Bead Hardness Tests on Plain Carbon, Nickel and Nickel-Chromium Steels
by OSCAR E. HARDER and C. B. VOLDRICH, Battelle Memorial Institute

Evaluation of Weldability by Correlation of Electrical Constants
by VICTOR PASCHKIS, Columbia University

Monday Evening—7:30 P.M.

EDUCATIONAL SESSION

Chairman—E. R. SEABLOOM, Crane Company

Vice-Chairman—R. E. McFARLAND, Western Electric Co.

General Electric Film on Atomic Hydrogen Welding

An Address on Welding in Ordnance Construction, by COL. S. B. RITCHIE, Chief of the Service Branch of the Chief of the Ordnance Office.

TUESDAY, OCTOBER 19th, Morning—9:30 A.M.

SIMULTANEOUS TECHNICAL SESSIONS

RESISTANCE WELDING

Chairman—

Vice-Chairman—C. L. PFEIFFER, Western Electric Co.

Flash Welding of Alloy Steels
by C. M. MANZER, General Electric Co.

The Spot Welding of Heavy Gauges of Carbon and Alloy Steels
by JOHN C. BARRETT, Taylor-Winfield Corp.

The Spot Welding of the Carbon Steels SAE 1020, SAE 1035 and SAE 1045 in the 0.040-In. Thickness
by WENDELL F. HESS, Rensselaer Polytechnic Institute

TUBING

Chairman—J. P. DODS, Summerill Tubing Co.
Vice-Chairman—H. S. CARD, Formed Steel Tube Institute

Welded Steel Tubing—Quality Control and Application
by R. D. MALM, Clayton Mark & Co.

Machine Welded Metal Tubing
by G. C. GRIDLEY, Mechanics Universal Joint Div., Borg-Warner Corp.

Oxyacetylene Tube Welding
by A. C. WEBER, Laclede Steel Co.

FLAME HARDENING AND HARD FACING

Chairman—D. H. COREY, The Detroit Edison Co.
Vice-Chairman—R. G. HAWLEY, Link Belt Ordnance Co.

Ordnance Flame Hardening
by S. SMITH and J. G. McILHINEY, Air Reduction Sales Co.

Hard Facing in the War on Wear
by J. A. GALLAHER, Haynes Stellite Co.

Hard Facing
by F. G. JONES, Wall-Colmonoy Corp.

SHIPS

Chairman—DAVID ARNOTT American Bureau of Shipping
Vice-Chairman—F. M. SCOTTEN, Great Lakes Engineering Works

Welding in Ship Construction
by H. A. MATIS and A. M. UNGER, Pullman-Standard Car Mfg. Co.

Prefabrication of Welded Ships in a Structural Steel Plant
by E. T. BLIX and J. C. ARNTZEN, Mississippi Valley Structural Steel Co.

Control of Welding in Ship Construction
by R. W. BRENDLE, Tampa Shipbuilding Co.

Tuesday Afternoon—2:00 P.M.

SIMULTANEOUS TECHNICAL SESSIONS

RESISTANCE WELDING

Chairman—R. E. POWELL, Western Electric Co.
Vice-Chairman—B. L. WISE, Federal Machine and Welder Co.

Why the Weld Recorder
by J. R. FETCHER and J. VAN DEN BEEMT, E. G. Budd Mfg. Co.

Double Pressure Systems as Applied to Resistance Welding Machines
by S. M. HUMPHREY, Taylor-Winfield Corp.

Stored Energy Welding of Mild Steel
by J. M. DIEBOLD, Yellow Truck and Coach Mfg. Co.

Flash Welding of Nickel and High Nickel Alloys
by W. F. HESS and A. MULLER, Rensselaer Polytechnic Institute

SHIPS

Chairman—JAMES C. BLAKE, Commander, USNR, Bureau of Ships
Vice-Chairman—H. W. PIERCE, New York Shipbuilding Corp.

Planning for Production Welding and Cutting in Modern Shipyards
by W. B. BOWEN, Ingalls Shipbuilding Corp.

Thermit Welding in Maritime Commission Work
by J. H. DEPPELER, Metal and Thermit Corp.

Longitudinal Welded Joints
by A. G. BISSELL, Bureau of Ships, Navy Dept.

RESEARCH

Chairman—H. C. BOARDMAN, Chicago Bridge & Iron Co.
Vice-Chairman—T. S. FULLER, General Electric Co.

Fatigue Strength of Fillet Welded Joints
by W. M. WILSON, University of Illinois

Some Notes on the Evaluating Weldability of Alloy Steels
by Lt. S. A. HERRES, Watertown Arsenal

Investigation of a Normalizing Procedure to Improve the Grain Structure of Welds in Carbon-Molybdenum Pipe
by I. A. ROHRIG, D. H. COREY and SABIN CROCKER, The Detroit Edison Company

Correlation of Structure and Strength of Spot Welds in Aluminum Alloys
by DANA SMITH and F. KELLER, Aluminum Company of America

Evening—7:30 P.M.

University Research Conference—H. C. BOARDMAN, Chairman, Presiding

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WEDNESDAY, OCTOBER 20th, Morning—9:30 A.M.

SIMULTANEOUS TECHNICAL SESSIONS

AIRCRAFT

Chairman—G. N. SIEGER, S-M-S Corporation
Vice-Chairman—J. R. DAWSON, Union Carbide & Carbon Res. Labs.

Fatigue Strength of Welded Aircraft Joints
by T. V. BUCKWALTER, The Timken Roller Bearing Co.

The Spotweldability of Low Carbon and Other Aircraft Steels
by L. C. BIBBER and JULIUS HEUSCHKEL, Carnegie-Illinois Steel Corp.

Weldability Tests of Aircraft Structural Steels
by C. B. VOLDRICH and R. D. WILLIAMS, Battelle Memorial Institute

NON-FERROUS WELDING AND BRAZING

Chairman—R. L. KOHLBRY, Machinery and Welder Corp.
Vice-Chairman—E. E. ISGREN, R. G. LeTourneau, Inc.

Modern Welding Methods for Copper and Copper Alloys
by J. J. VREELAND, Chase Brass and Copper Co. Inc.

Carbon Arc Welding of Naval Brass
by KENNETH L. WALKER, Foster Wheeler Corp.

Aluminum Brazing Sheet—Fundamentals of Metal Flow
by M. A. MILLER, Aluminum Research Laboratories

PIPING

Chairman—F. C. FANTZ, Midwest Piping and Supply Co.
Vice-Chairman—F. C. FYKE, Standard Oil Development Co.

Oxyacetylene Distribution Systems
by D. F. GUTHRIE and R. W. STEWART, Air Reduction Sales Co.

Large Welded Pipe Lines
by L. G. CHRISTOFFERSON, Chicago Bridge & Iron Co.

Weldability of 27% Chrome Steel Pipe
by R. A. MUELLER, I. H. CARLSON and E. R. SEABLOOM, Crane Co.

Wednesday Afternoon—2:00 P.M.

SIMULTANEOUS TECHNICAL SESSIONS

AIRCRAFT

Chairman—G. S. MIKHALAPOV, War Metallurgy Committee, National Research Council
Vice-Chairman—R. T. GILLETTE, General Electric Co.

The Heliarc Welding of Magnesium Alloys as Used in Airplane Fabrication and Substitution for Critical Materials
by T. E. PIPER, Northrop Aircraft, Inc.

Fatigue Studies of Welded Test Triangular Structures with NE8630 Steels
by A. I. WILLIAMSON, Summerill Tubing Co.

Fabrication and Welding of Aircraft Exhaust Tubing - Manifolds and Headers
by C. D. LaFOND, Buhl Stamping Co.

Metallic Arc Welded X4130 Steel Tubing
by W. T. TIFFIN, University of Oklahoma

INSPECTION, QUALIFICATION AND TRAINING

Chairman—O. B. J. FRASER, International Nickel Co.
Vice-Chairman—L. M. SKIDMORE, General Motors Institute

Symposium on Applicable Methods of Inspection of Arc Welding for
(1) **Shipbuilding**—J. LYELL WILSON
(2) **Structural**—R. B. LINCOLN
(3) **Pressure Vessels and Piping**—W. D. HALSEY
(4) **Aircraft**—J. B. JOHNSON
(5) **Machinery**—N. L. MOCHEL

General Problems of Training Welding Operators
by A. N. KUGLER, Air Reduction Sales Co.

REPAIR AND MAINTENANCE

Chairman—L. S. McPHEE, Whiting Corp.
Vice-Chairman—E. C. BRECKELBAUM, Harnischfeger Corp.

Bronze Welding in the Design and Maintenance of Forming Dies
by C. E. SWIFT, Ampco Metal, Inc.

The Job Shop—Past, Present and Future
by F. W. SHACKLETON, Central Ohio Welding Co.

Maintenance of Tools and Equipment
by T. B. JEFFERSON, The Welding Engineer

Reclamation of Tools by Low Temperature Brazing
by W. A. JOHNSON, International Harvester Co.

Evening—7:30 P.M.

Section Officers Dinner and Conference

THURSDAY, OCTOBER 21st, Morning—9:30 A.M.

SIMULTANEOUS TECHNICAL SESSIONS

AIRCRAFT

Chairman—P. H. MERRIMAN, Glenn L. Martin Co.
Vice-Chairman—H. O. KLINKE, Republic Aviation Corp.

Quality Control of Aircraft Spot Welding
by NATHAN C. CLARK, Lockheed Aircraft Research Lab.

The Application of Flash Welding in Airplane Construction
by C. B. SMITH, Douglas Airplane Co.

Spot Weld Joint Efficiency for Aluminum Alloys
by C. W. STEWARD, Curtiss-Wright Corp. Research Laboratory

Spot Welding of Magnesium Alloys
by W. S. LOOSE, Aircraft Welding Research Committee WRC.

PRODUCTION

Chairman—A. M. CANDY, Hollup Corp.
Vice-Chairman—OTIS L. SMITH, Weldit Acetylene Co.

Automatic Arc Welding Solves Production Problems
by R. F. WYER, General Electric Co.

Transition from Riveted to Welded Construction of Light Tanks
by WM. OSHA and J. W. SHEFFER, American Car and Foundry Co.

Welding of Armored Tanks
by WILLIAM BOESE, Pullman Standard Car Mfg. Co.

PRESSURE VESSELS

Chairman—ISAAC HARTER, Babcock & Wilcox Co.
Vice-Chairman—W. E. CRAWFORD, A. O. Smith Corp.

War Emergency Codes for Welded Pressure Vessels
by E. R. FISH, Hartford Steam Boiler Insp. & Ins. Co.

The Hammer Test for Welded Pressure Vessels: An Investigation
by C. O. DOHRENWEND, Armour Research Foundation

Thursday Afternoon—2:00 P.M.

Business Meeting

3:00 P.M.

Board of Directors Meeting

SOCIETY HEADQUARTERS—HOTEL MORRISON, CHICAGO

In order not to be disappointed, members of the Society are urged to make reservations promptly by writing to Leonard Hicks, Jr., Morrison Hotel, Chicago. It is imperative that these letters mention the name "American Welding Society Convention."

The rates for single rooms are $3.30, $3.85, $4.40, $5.50. The rates for double rooms are $4.40, $4.95, $5.50, $6.60, $7.70, $8.80. Rooms with twin beds are from $5.50 up. A large number of suites are available ranging in price from $9.90 on up depending upon the number of rooms and space.

Inasmuch as it is believed that the Hotel will be filled, members are requested to indicate their exact stay so that the rooms may be rented to members coming in later.